

DRAFT OF FEASIBILITY STUDY
FOR THE
JASCO CHEMICAL CORPORATION SITE
MOUNTAIN VIEW, CALIFORNIA

VOLUME II: APPENDIX A THROUGH D



OHM Corporation

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APPENDIX A

SUMMARY OF GROUNDWATER ANALYTICAL RESULTS

TABLE 4.9
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER – MONITOR WELL V-1 (mg/l)

Constituent	July 1984	Nov 1986	Aug 1987	Sept 1987	Jan 1988	March 1988	June 1988	Oct 1988
Volatile Organics (EPA methods 601/624)								
1,1,1-Trichloroethane	0.009	na	<0.0005	<0.0005	<0.0005	<0.002	<0.002	<0.002
1,1-Dichloroethane	na	na	<0.0005	0.0039	0.004	0.005	0.0066	0.0043
1,1-Dichloroethene	na	na	<0.0005	0.0058	0.0007	<0.002	<0.002	<0.002
Chloroethane	na	na	<0.0005	<0.0005	0.0031	<0.002	<0.002	<0.002
Methylene Chloride	na	0.018	<0.0005	<0.0005	0.0014	0.026	<0.01	<0.01
Trans-1,2-DCE	na	na	na	0.0014	0.0016	<0.002	<0.002	<0.002
Non-Halogenated Volatile Organics (EPA method 8015)								
Acetone	0.098	na	<1.0	<0.05	0.014	<0.01	0.98	<0.01
Ethanol	<0.02	na	<1.0	<0.05	<0.01	<0.01	0.55	na
Isopropanol	<0.030	na	<1.0	<0.05	<0.01	<0.01	0.44	na
Methanol	0.095	na	<1.0	<0.05	<0.01	<0.01	1.4	na
Methyl ethyl ketone	0.004	na	<0.0005	<0.0005	<0.001	na	na	na
High Boiling Pt. HC	na	na	<1.0	<1.0	0.36	<0.05	<1.0	<1.0
TPH as paint thinner	0.86	na	<1.0	<1.0	na	na	<1.0	<1.0
Phenols (EPA method 604)								
4-Nitrophenol	na	na	<0.001	<0.01	<0.005	<0.015	<0.05	<0.01
Pentachlorophenol	0.0002	na	<0.001	<0.01	<0.01	<0.01	<0.05	<0.025

na – Analyses not conducted.

Constituent	Jan 1989	Sept 1989	Dec 1989	Jan 1990	April 1990	July 1990	Oct 1990
Volatile Organics (EPA methods 601/624)							
1,1,1-Trichloroethane	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethane	<0.002	0.0037	0.0032	0.0052	0.0082	0.0056	0.0021
1,1-Dichloroethene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chloroethane	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Methylene Chloride	<0.002	0.014	<0.002	<0.002	0.0068	0.017	0.0077
Trans-1,2-DCE	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Non-Halogenated Volatile Organics (EPA method 8015)							
Acetone	<0.01	<0.015	<0.015	0.038	<0.015	<0.015	<0.015
Ethanol	<0.01	0.16	<0.05	<0.05	<0.05	<0.05	<0.05
Isopropanol	<0.01	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Methanol	<0.05	0.2	<0.06	<0.06	<0.06	<0.06	<0.06
Methyl ethyl ketone	na	na	na	na	na	na	na
High Boiling Pt. HC	0.15	0.2	0.3	1.1	0.97	0.61	<0.05
TPH as paint thinner	na	na	na	na	na	na	na
Phenols (EPA method 604)							
4-Nitrophenol	<0.05	<0.02	<0.04	<0.02	0.037	<0.02	<0.02
Pentachlorophenol	<0.05	<0.02	<0.04	<0.02	0.023	<0.02	<0.02

na – Analyses not conducted.

TABLE 4.10
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER - MONITOR WELL V-2 (mg/l)

Constituent	July 1986	Nov 1986	Dec 1986	Feb 1987	March 2 1987	March 19 1987	May 1987	June 1987	July 1987	Sept 1987	Oct 1987	Jan 1988
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Volatile Organics (EPA methods 601/624)

1,1,1-Trichloroethane	<0.006	na	0.54	2.04	0.61	0.51	0.41	0.077	0.27	0.63	0.5	0.2
1,1-Dichloroethane	na	na	0.88	<0.5	1.2	0.9	0.54	0.33	0.63	0.49	0.7	0.25
1,1-Dichloroethene	na	na	<0.005	<0.5	0.11	<0.05	0.051	0.029	<0.05	<0.05	0.076	0.026
1,2-Dichloroethane	na	na	<0.005	2.58	<0.005	<0.05	<0.005	<0.0005	<0.05	<0.05	na	0.0065
trans 1,2-Dichloroethene	na	na	<0.005	<0.5	<0.005	<0.05	<0.005	0.013	<0.05	<0.05	na	0.0046
1,3-Dichlorobenzene	na	na	<0.005	<0.5	<0.005	<0.05	<0.005	<0.0005	<0.05	<0.05	na	0.025
Chlorobenzene	na	na	na	<0.5	<0.005	<0.05	<0.005	<0.0005	<0.05	<0.05	0.037	0.0005
Chloroethane	na	na	0.17	<0.5	0.08	<0.05	0.006	0.14	<0.05	<0.05	0.026	0.18
Dichloromethane	3.2	na	na	na	na	na	na	na	na	na	na	na
Methylene Chloride	na	142	30	86	1.6	2.4	0.7	0.84	0.27	0.22	4.6	6.8
Tetrachloroethene	na	na	0.008	<0.5	<0.005	<0.05	<0.005	<0.0005	<0.05	<0.05	na	0.0006
Trichloroethene	<0.006	na	0.019	<0.5	<0.005	<0.05	0.013	0.0022	<0.05	<0.05	na	0.012
Vinyl Chloride	na	na	<0.005	<0.5	<0.005	<0.05	<0.005	0.0092	<0.05	<0.05	na	0.0072

Non-Halogenated Organics (EPA method 8015)

Acetone	<0.015	na	na	na	na	na	na	na	<1.0	0.95	na	1.8
Methyl ethyl ketone	<0.015	na	na	na	na	na	na	na	<0.05	<0.05	0.027	0.014
Ethanol	<0.02	na	na	na	na	na	na	na	<1.0	<0.05	na	0.026
Isopropanol	<0.02	na	na	na	na	na	na	na	<1.0	<0.05	na	0.092
High boiling pt. HC	na	na	na	na	na	na	na	na	<1.0	<1.0	na	47

Purgeable Aromatics (EPA method 602)

Benzene	na	na	na	na	na	na	na	<0.0005	<0.05	<0.05	0.007	0.0005
Toluene	na	na	na	na	na	na	na	0.015	<0.05	<0.05	0.2	0.035
Xylenes	na	na	na	na	na	na	na	<0.0005	<0.05	0.026	0.044	0.08
Ethylbenzene	na	na	na	na	na	na	na	<0.0005	<0.05	<0.05	<0.05	0.012

Phenols (EPA method 8040)

Pentachlorophenol	0.0015	na	na	na	na	na	na	na	<0.001	<0.01	na	<0.01
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na - Analyses not conducted.

Note: Monitor well V-2 has been destroyed.

TABLE 4.11
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER – MONITOR WELL V-3 (mg/l)

Constituent	Nov 1986	Jan 1987	Aug 1987	Sept 1987	Jan 1988	March 1988	June 1988
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Volatile Organics (EPA methods 601/624)

1,1,1-Trichloroethane	<0.0005	<0.0005	0.0018	0.0011	0.0008	<0.002	<0.002
1,1-Dichloroethane	na	<0.0005	0.015	0.0066	0.008	0.0042	0.0064
1,1-Dichloroethene	na	<0.0005	0.0013	0.00076	0.0008	<0.002	<0.002
1,2-Dichloroethane	na	<0.0005	0.001	<0.0005	<0.0005	<0.002	<0.002
Methylene Chloride	0.0076	<0.0005	0.0063	0.012	0.0008	<0.002	<0.01
Trans-1,2-Dichloroethene	na	0.004	0.012	0.0091	0.004	0.0048	0.0021
Vinyl Chloride	na	<0.0005	<0.0005	0.00068	0.0006	<0.002	<0.002

Non-Halogenated Volatile Organics (EPA method 8015)

Acetone	<1.0	<1.0	<1.0	<0.05	<0.01	<0.01	<0.01
Ethanol	<1.0	<1.0	<1.0	<0.05	<0.01	<0.01	<0.01
Methanol	0.0027	<0.001	<1.0	<0.05	<0.01	<0.01	<0.01
High Boiling Point HC	na	na	<1.0	<1.0	20	<0.05	<1.0

Phenols (EPA method 604)

Pentachlorophenol	0.05	<0.001	<0.001	<0.01	<0.01	<0.01	<0.01
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Semi-Volatile Organics (EPA method 8270)

1-[2-(2-Methoxy-1-Methoxy)-1-Methoxy]-2-Propanol	na	na	na	na	na	na	na
4-Butoxybutanoic Acid	na	na	na	na	na	na	na
Benzene	na	na	<0.0005	<0.0005	<0.005	<0.005	<0.002
Xylenes	na	na	0.008	<0.0005	<0.001	na	<0.002

na – Analyses not conducted.

TABLE 4.11 (cont.)
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER – MONITOR WELL V-3 (mg/l)

Constituent	Oct 1988	Jan 1989	Aug 1989	Dec 1989	Jan 1990	April 1990	July 1990	Oct 1990
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Volatile Organics (EPA methods 601/624)

1,1,1-Trichloroethane	<0.002	<0.002	0.0026	0.0022	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethane	0.003	0.0078	0.008	0.0064	0.0047	0.0033	0.0023	<0.002
1,1-Dichloroethene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,2-Dichloroethane	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Methylene Chloride	<0.01	0.0021	0.29	0.011	0.014	0.053	0.0064	<0.002
Trans-1,2-Dichloroethene	<0.002	0.0032	0.2	<0.002	<0.002	<0.002	<0.002	<0.002
Vinyl Chloride	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

Non-Halogenated Volatile Organics (EPA method 8015)

Acetone	<0.01	<0.01	<0.015	0.036	0.02	<0.01	<0.01	<0.01
Ethanol	na	<0.01	2.7	<0.05	<0.05	<0.05	<0.05	<0.05
Methanol	na	<0.01	0.31	<0.06	3.8	<0.06	<0.06	<0.06
High Boiling Point HC	5.8	6.2	33	0.92	0.25	0.27	0.15	<0.05

Phenols (EPA method 604)

Pentachlorophenol	<0.01	<0.002	<0.002	<0.02	<0.01	<0.01	<0.01	<0.01
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Semi-Volatile Organics (EPA method 8270)

1-[2-(2-Methoxy-1-Methoxy)-1-Methyloxy]-2-Propanol	na	0.39	na	na	na	na	na	na
4-Butoxybutanoic Acid	na	0.049	na	na	na	na	na	na
Benzene	<0.002	0.011	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Xylenes	<0.002	0.003	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

na – Analyses not conducted.

TABLE 4.12 (cont.)
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER - MONITOR WELL V-4 (mg/l)

Constituent	June 1988	Oct 1988	Jan 1989	Aug 1989	Dec 1989	Jan 1990	April 1990	July 1990	Oct 1990
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Volatile Organics (EPA methods 601/624)

1,1,1-Trichloroethane	0.086	0.054	0.99	0.069	1.7	0.14	0.041	0.048	0.042
1,1-Dichloroethane	0.25	0.23	0.68	0.27	7.8	0.29	0.23	0.24	0.14
1,1-Dichloroethene	0.045	0.042	0.066	0.033	0.19	0.029	0.021	0.038	<0.005
1,2-Dichloroethane	<0.002	<0.002	<0.002	<0.002	<0.1	<0.004	<0.004	<0.002	<0.005
trans 1,2-DCE	<0.002	<0.002	<0.02	<0.002	<0.1	<0.004	<0.004	<0.002	<0.005
Bromoform	<0.002	<0.002	<0.02	<0.002	<0.1	<0.004	<0.004	<0.002	<0.005
Chlorobenzene	<0.002	<0.002	<0.02	<0.002	<0.1	<0.004	<0.004	<0.002	<0.005
Chloroethane	0.013	0.016	<0.02	0.013	0.39	0.0066	0.0061	0.012	<0.005
Dibromochloromethane	<0.002	<0.002	<0.02	<0.002	<0.1	<0.004	<0.004	<0.002	<0.005
Methylene Chloride	<0.01	<0.01	0.55	<0.002	3.5	0.015	0.005	<0.002	<0.005
Toluene	<0.002	<0.002	<0.02	<0.002	<0.1	<0.004	<0.004	<0.002	<0.005
Vinyl Chloride	<0.002	<0.002	<0.02	0.0026	<0.1	0.0054	0.0053	0.005	<0.005

Non-Halogenated Volatile Organics (EPA method 8015)

Acetone	<0.01	<0.01	<0.01	<0.01	1.7	0.1	<0.01	<0.01	<0.01
Ethanol	<0.01	na	na	<0.05	16	0.2	<0.05	<0.05	<0.05
Isopropanol	<0.01	na	na	<0.06	1.4	<0.02	<0.02	<0.02	<0.02
Methanol	<0.01	na	na	0.73	0.17	<0.06	<0.06	<0.06	<0.06
High Boiling Point HC	<1.0	<1.0	0.27	0.082	2.1	0.12	0.24	0.35	<0.05

Phenols (EPA method 604)

Phenol	<0.002	0.0032	<0.002	<0.002	0.004	<0.002	<0.002	<0.002	<0.002
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na - Analyses not conducted.

TABLE 4.12
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER – MONITOR WELL V-4 (mg/l)

Constituent	April 1987	May 1987	June 1987	Aug 1987	Sept 25 1987	Sept 27 1987	Jan 1988	March 1988
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Volatile Organics (EPA methods 601/624)

1,1,1-Trichloroethane	1.3	0.39	0.17	0.06	0.03	0.02	0.25	0.14
1,1-Dichloroethane	2.2	1.2	0.5	0.4	0.31	1.0	0.53	0.36
1,1-Dichloroethene	0.17	0.14	0.15	0.036	0.014	0.028	0.063	0.06
1,2-Dichloroethane	<0.01	<0.005	<0.0005	<0.005	<0.005	0.008	0.0041	<0.004
trans 1,2-Dichloroethene	<0.01	<0.005	0.0066	<0.005	<0.005	na	<0.005	<0.004
Bromoform	<0.01	<0.005	<0.0005	<0.005	<0.005	na	0.003	<0.004
Chlorobenzene	na	na	<0.0005	<0.005	<0.005	0.008	<0.005	<0.004
Chloroethane	0.16	0.012	0.065	<0.005	0.039	0.059	0.028	0.012
Dibromochloromethane	<0.01	<0.005	<0.0005	<0.005	<0.005	na	0.0026	<0.004
Methylene Chloride	1.4	0.49	0.11	<0.005	<0.005	0.003	0.21	0.031
Toluene	na	na	0.0038	<0.005	<0.005	0.017	0.014	<0.004
Vinyl Chloride	0.011	<0.005	0.016	<0.005	<0.005	na	0.01	<0.004

Non-Halogenated Volatile Organics (EPA method 8015)

Acetone	na	na	na	<1.0	<0.05	na	0.018	<0.05
Ethanol	na	na	na	<1.0	<0.05	na	<0.01	<0.01
Isopropanol	na	na	na	<1.0	<0.05	na	<0.01	<0.01
Methanol	na	na	na	<1.0	<0.05	na	<0.01	<0.01
High Boiling Point HC	na	na	na	<1.0	<1.0	na	2.2	<0.05

Phenols (EPA method 604)

Phenol	na	na	na	<0.001	<0.01	na	<0.01	<0.01
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na – Analyses not conducted.

TABLE 4.13
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER - MONITOR WELL V-5 (mg/l)

Constituent	May 1987	June 1987	Aug 1987	Sept 1987	Jan 1988	March 1988
Non-Halogenated Volatile Organics (EPA method 8015)						
Acetone	<1.0	na	<1.0	<0.05	<0.01	<0.01

na - Analyses not conducted

Constituent	June 1988	Oct 1988	Jan 1989	Aug 1989	Jan 1990	July 1990
Non-Halogenated Volatile Organics (EPA method 8015)						
Acetone	0.12	<0.01	<0.01	<0.01	<0.01	<0.01

na - Analyses not conducted

TABLE 4.15
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER SAMPLES – MONITOR WELL V-7 (mg/l)

Constituent	May 1987	June 1987	Aug 1987	Sept 1987	Jan 1988	March 1988	June 1988	Oct 1988
Volatile Organics (EPA methods 601/624)								
1,1,1-Trichloroethane	0.064	0.028	0.016	0.023	0.012	0.018	0.013	0.031
1,1-Dichloroethane	0.055	0.049	0.024	0.019	0.014	0.029	0.028	0.01
1,1-Dichloroethene	0.0077	<0.0002	0.0019	0.0024	0.0035	0.0081	0.006	0.0029
Acetone	<1.0	na	<1.0	<0.050	<0.01	<0.01	<0.01	<0.01
Carbon Tetrachloride	0.005	<0.0005	<0.0005	<0.0005	<0.0005	<0.002	<0.002	<0.002
Chloroform	<0.0016	<0.0005	<0.0005	<0.0005	0.0007	<0.01	<0.01	<0.01
Methylene Chloride	<0.0028	<0.0005	<0.0005	<0.0005	<0.0005	<0.01	<0.01	<0.01
Vinyl Chloride	<0.005	<0.0005	<0.0005	<0.0005	0.0012	<0.002	<0.002	<0.002

na – Analyses not conducted.

Constituent	Jan 1989	Jan 1989	Aug 1989	Dec 1989	Jan 1990	April 1990	July 1990	Oct 1990
Volatile Organics (EPA methods 601/624)								
1,1,1-Trichloroethane	0.0087	0.012	0.0067	<0.002	0.0033	0.0043	0.0034	0.0064
1,1-Dichloroethane	0.016	0.02	0.012	0.005	0.015	0.013	0.0075	0.0094
1,1-Dichloroethene	0.0043	0.007	0.0033	<0.002	0.0034	0.0037	0.0032	<0.002
Acetone	<0.01	<0.01	<0.01	0.012	<0.01	<0.01	<0.01	<0.01
Carbon Tetrachloride	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Chloroform	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Methylene Chloride	<0.002	<0.002	0.0048	0.0048	<0.002	<0.002	<0.002	<0.002
Vinyl Chloride	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

na – Analyses not conducted.

TABLE 4.14`
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER - MONITOR WELL V-6 (mg/l)

[illegible]

Constituent	June 1988	Oct 1988	Jan 1989	Aug 1989	Jan 1990	July 1990
Volatile Organics (EPA methods 601/624)						
1,1,1-Trichloroethane	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Benzene	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
na - Analyses not conducted						

TABLE 4.16
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER SAMPLES - MONITOR WELL V-8
(mg/l)

Constituent	March 8 1988	March 22 1988	June 1988	Oct 1988	Jan 1989	Aug 1989
Volatile Organics (EPA method 601/624)						
1,1,1-Trichloroethane	0.0035	0.0037	0.0026	0.0024	0.004	0.0028
1,1-Dichloroethane	<0.002	0.00069	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethene	<0.002	0.00065	<0.002	<0.002	<0.002	<0.002
2-Propanone	0.003	na	na	na	na	na

na - Analyses not conducted.

Constituent	Dec 1989	Jan 1990	April 1990	July 1990	Oct 1990
Volatile Organics (EPA method 601/624)					
1,1,1-Trichloroethane	0.0025	0.0026	0.0026	0.0031	0.002
1,1-Dichloroethane	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethene	<0.002	<0.002	<0.002	<0.002	<0.002
2-Propanone	na	na	na	na	na

na - Analyses not conducted.

TABLE 4.17
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER SAMPLES - MONITOR WELL V-9
(mg/l)

Constituent	March 8 1988	March 22 1988	June 1988	Oct 1988	Jan 1989
Volatile Organics (EPA methods 601/624)					
1,1,1-Trichloroethane	<0.002	0.0022	<0.002	<0.002	<0.002
1,1-Dichloroethane	0.0036	0.0039	0.0031	0.0039	0.0028
2-Propanone	0.0051	na	na	na	na
Toluene	<0.002	<0.0005	<0.002	<0.002	<0.002
Non Halogenated Volatile Organics (EPA Method 8015)					
Methanol	<0.01	na	0.54	na	na

na - Analyses not conducted.

Constituent	Aug 1989	Dec 1989	Jan 1990	April 1990	July 1990
Volatile Organics (EPA methods 601/624)					
1,1,1-Trichloroethane	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethane	0.0027	0.0029	0.0028	0.0026	0.0026
2-Propanone	na	na	na	na	na
Toluene	<0.002	0.0023	<0.002	<0.002	<0.002
Non Halogenated Volatile Organics (EPA Method 8015)					
Methanol	<0.06	<0.06	<0.06	<0.06	<0.06

na - Analyses not conducted.

TABLE 4.18
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER SAMPLES
MONITOR WELL V-10
(mg/l)

Constituent	March 9 1988	March 22 1988	June 1988	Oct 1988	Jan 1989	Aug 1989
Volatile Organics (EPA methods 601/624)						
1,1,1-Trichloroethane	<0.002	0.00096	<0.002	<0.002	<0.02	<0.002
Methylene Chloride	<0.01	<0.0005	<0.01	<0.01	2.0	<0.002
Non-Halogenated Volatile Organics (EPA method 8015)						
Acetone	<0.01	na	1.3	0.023	<0.01	<0.015
Ethanol	<0.01	na	0.17	na	<0.01	<0.05
Isopropanol	<0.01	na	0.33	na	<0.01	<0.02

na - Analyses not conducted.

Constituent	Dec 1989	Jan 1990	April 1990	July 1990	Oct 1990
Volatile Organics (EPA methods 601/624)					
1,1,1-Trichloroethane	<0.002	<0.002	<0.002	<0.002	<0.002
Methylene Chloride	<0.002	0.003	0.0039	<0.002	<0.002
Non-Halogenated Volatile Organics (EPA method 8015)					
Acetone	<0.01	<0.01	<0.01	<0.01	<0.01
Ethanol	<0.05	<0.05	<0.05	<0.05	<0.05
Isopropanol	<0.02	<0.02	<0.02	<0.02	<0.02

na - Analyses not conducted.

TABLE 4.19
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER - MONITOR WELL V-11

Constituent	June 1990	Oct 1990		
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No target constituents were detected exceeding the minimum detection limit

TABLE 4.20
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER – MONITOR WELL V-12

Constituent	June 1990	Oct 1990		
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No target constituents were detected exceeding the minimum detection limit
--

TABLE 4.21
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER SAMPLES - MONITOR WELL I-1 (mg/l)

Constituent	May 1987	June 3 1987	June 22 1987	Aug 1987	Sept 1987	Jan 1988	March 1988	June 1988
Volatile Organics (EPA methods 601/624)								
1,1,1-Trichloroethane	<0.0038	<0.005	<0.005	0.0019	0.002	0.0021	<0.002	<0.002
1,1-Dichloroethane	0.011	0.0039	<0.005	0.0023	0.003	0.0012	0.0029	<0.002
Acetone	na	na	na	<1.0	<0.05	<0.01	<0.01	0.13
Methylene Chloride	<0.0028	<0.005	0.032	<0.0005	<0.0005	<0.0005	<0.01	<0.01

na - Analyses not conducted.

Constituent	Oct 1988	Jan 1989	Aug 1989	Dec 1989	Jan 1989	April 1990	July 1990	Oct 1990
Volatile Organics (EPA methods 601/624)								
1,1,1-Trichloroethane	0.0021	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002
1,1-Dichloroethane	<0.002	0.0026	0.002	<0.002	<0.002	<0.002	<0.002	<0.002
Acetone	0.024	<0.01	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01
Methylene Chloride	<0.01	<0.01	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002

na - Analyses not conducted.

TABLE 4.22
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER SAMPLES
MONITOR WELL I-2
(mg/l)

Constituent	Aug 1987	Sept 1987	Jan 1988	March 1988	June 1988	Oct 1988	Jan 1989
Volatile Organics (EPA methods 601/624)							
1,1,1-Trichloroethane	0.0068	<0.0005	0.0032	0.003	0.0039	0.0038	0.0028
1,1-Dichloroethane	0.014	<0.0005	0.01	0.0045	0.0051	0.0037	0.0036
1,1-Dichloroethene	0.0071	<0.0005	0.003	0.0024	0.0029	<0.002	0.0021
Acetone	na	<0.05	<0.01	<0.01	<0.01	0.019	<0.01

na - Analyses not conducted.

Constituent	Aug 1989	Dec 1989	Jan 1990	April 1990	July 1990	Oct 1990
Volatile Organics (EPA methods 601/624)						
1,1,1-Trichloroethane	0.0027	0.0036	0.0032	0.0022	0.003	<0.002
1,1-Dichloroethane	0.0035	0.0046	0.0029	0.0025	0.003	<0.002
1,1-Dichloroethene	0.0023	0.0026	<0.002	<0.002	0.0022	<0.002
Acetone	<0.015	<0.01	<0.01	<0.01	<0.01	<0.01

na - Analyses not conducted.

TABLE 4.23
SUMMARY OF RESULTS OF ANALYSES OF GROUNDWATER SAMPLES
MONITOR WELL I-3
(mg/l)

Constituent	Aug 1987	Sept 1987	Jan 1988	March 1988	June 1988
Volatile Organics (EPA methods 601/624)					
Vinyl Chloride	<0.0005	<0.0005	0.004	<0.002	<0.002
Phenols (EPA method 8040)					
Phenol	na	0.02	<0.01	<0.01	<0.002

na - analyses not conducted

Constituent	Oct 1988	Jan 1989	Aug 1989	Jan 1990	July 1990
Volatile Organics (EPA methods 601/624)					
Vinyl Chloride	<0.002	<0.002	<0.002	<0.002	<0.002
Phenols (EPA method 8040)					
Phenol	<0.003	<0.002	<0.002	<0.002	0.0036

na - analyses not conducted

TABLE 4.24
COMPARISON OF LABORATORY RESULTS OF GROUNDWATER SAMPLING
BEFORE JAN,1987 and 1990
JASCO CHEMICAL CORPORATION

Constituent	Maximum Concentration in Groundwater 1984 to Jan,1988 mg/l	Well	Maximum Concentration in Groundwater 1990 mg/l	Well
1,1,1-TCA	2.04	V-2	0.14	V-4
1,1-DCA	2.2	V-4	0.29	V-4
1,1-DCE	0.17	V-4	0.038	V-4
1,2-DCA	2.58	V-2	<0.004	
1,3-Dichlorobenzene	0.025	V-2	<0.004	
Trans-1,2-DCE	0.013	V-2	<0.004	
4-Nitrophenol	<0.015		0.037	V-1
Acetone	0.95	V-2	0.1	V-4
Benzene	0.007	V-2	<0.004	
Bromoform	0.003	V-4	<0.004	
Chlorobenzene	0.037	V-2	<0.004	
Chloroethane	0.17	V-2	0.012	V-4
Dibromochloromethane	0.0026	V-4	<0.004	
Dichloromethane	3.2	V-2	<0.004	
Ethanol	<1.0		0.2	V-4
Ethylbenzene	0.012	V-2	<0.004	
High B.P. Hydrocarbons	20	V-3	1.1	V-1
Isopropanol	<1.0		<0.06	
Methanol	0.095	V-1	3.8	V-3
Methyl Ethyl Ketone	0.004	V-1	na	
Methylene Chloride	142	V-2	0.053	V-3
Pentachlorophenol	0.05	V-3	0.023	V-1
Phenol	0.02	I-3	0.0036	I-3
Tetrachloroethene	0.008	V-2	<0.004	
Toluene	0.2	V-2	<0.004	
Trichloroethene	0.019	V-2	<0.004	
Vinyl Chloride	0.016	V-4	0.0054	V-4
Xylene	0.044	V-2	<0.004	

APPENDIX B

JACOB'S AUGUST 1989 ENDANGERMENT ASSESSMENT

ENVIRONMENTAL PROTECTION AGENCY
TECHNICAL ENFORCEMENT SUPPORT
AT
HAZARDOUS WASTE SITES

TES IV
CONTRACT NO. 68-01-7351
WORK ASSIGNMENT NO. C09008
ENDANGERMENT ASSESSMENT
FOR
JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CA
EPA REGION IX
SITE ACCOUNT NUMBER: 9BF6

JACOBS ENGINEERING GROUP INC.

PROJECT NUMBER 05-B810-00

AUGUST 1989

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EXECUTIVE SUMMARY

This Endangerment Assessment represents the public health evaluation associated with the Jasco Chemical Corporation site, located in the City of Mountain View, California. Exposure pathways were defined to illustrate the potential effects upon human receptors and estimates of the risks associated with these pathways were determined.

The guidance documents used for this assessment were the U.S. EPA Superfund Public Health Evaluation Manual and Exposure Assessment Manual. The Endangerment Assessment was completed using the following procedures:

- 1) Analyzing high probability and low probability exposure scenarios at or near the site which would be expected to occur in the absence of remedial measures.
- 2) Estimating the likely range of contaminants concentrations to which individuals who participate in the exposure scenarios may be exposed.
- 3) Determining best estimate and maximum plausible values for human intake of contaminants from exposure scenarios developed for the site.
- 4) Characterizing the health effects and health risks to which individuals who are involved in the exposure scenarios may be subjected.

The criteria used to differentiate between risk levels of concern and those that are less significant were the following:

- 1) A non-carcinogenic risk was considered significant when a chemical intake equaled or exceeded its acceptable chronic or subchronic intake value.
- 2) A "one in a million" risk or one excess cancer risk in a population of 10^6 after a 70-year exposure period was considered significant in determining carcinogenic risks.

(These criteria were used to characterize and differentiate risks estimated in this Endangerment Assessment only, and should not be considered as the only criteria by which to judge and evaluate any future remediation efforts at the Jasco site.)

Under current land-use conditions of the site the only complete exposure pathway was associated with inhalation of volatilized contaminants originating from the soils. A screening analysis was conducted and it was determined that the potential cancer risk associated with inhalation of volatilized contaminants was 5.8×10^{-7} . This risk is within the 10^{-4} to 10^{-7} range which is considered by USEPA to be protective of human health after remediation.

Potential carcinogenic and non-carcinogenic risks were calculated for each of the exposure scenarios associated with potential future land-use conditions (residential occupancy). The risk calculations were made for representative contaminant concentrations (best estimate) and highest measured contaminant concentrations (maximum plausible). As a result each scenario is associated with four risk calculations; best estimate - carcinogenic; best estimate - non-carcinogenic; maximum plausible - carcinogenic and maximum plausible - non-carcinogenic. Results of the findings are as follows:

- 1) Significant carcinogenic risks were calculated for private well water (A-aquifer) consumption and inhalation of vapors originating from contaminated ground water. Potential excess lifetime cancer risk were determined to be 3.6×10^{-3} (best estimate) and 4.0×10^{-3} (maximum plausible) for ground water ingestion, and 2.7×10^{-4} (best estimate) and 5.9×10^{-4} (maximum plausible) for vapor inhalation.
- 2) Significant non-carcinogenic risks were calculated for ground water ingestion using representative and highest measured contaminant concentrations.
- 3) Potential carcinogenic and non-carcinogenic risks associated with exposure to on-site contaminated soils via incidental ingestion or fugitive dust inhalation were not significant.

The Endangerment Assessment has demonstrated that contaminants detected at the Jasco site pose no threat to public health under current land-use conditions. However potential future land-use scenario are described which could pose higher health risks. The assessment identifies pathways that might be impacted by remedial activity and can be used to facilitate the selection of remedial action alternatives.

SECTION 1.0

INTRODUCTION

The remedial investigation conducted at the Jasco Chemical Corporation (Jasco) site has characterized the impacts of the site on the quality of ground water, surface water and soils. This Endangerment Assessment is a basis for evaluating whether or not corrective action is necessary at the site and defines goals for corrective action. The evaluation considers the nature of chemical releases from the site, the potential pathways for human and environmental exposure to the releases, and the degree to which the concentration at the point of exposure exceeds existing standards or acceptable criteria.

The purpose of the Endangerment Assessment is to evaluate the impact to public health that may result from releases from the Jasco site. The assessment considers risks based on current exposure pathways and potential risks that may result from future exposure pathways if no action is taken. A human exposure pathway consists of four elements: a source and mechanism of chemical release, an environmental transport medium such as air or ground water, a point of potential human contact with the medium and a human exposure route such as inhalation of air or ingestion of ground water at the contact point. All four elements must be present to complete a pathway. For the Jasco site, both a current exposure pathway and potential future exposure pathways are evaluated assuming a no remediation scenario.

The baseline evaluation for the Jasco site considers four areas of study: ground water quality, surface water quality, soils and air quality. The objective of the assessment is to characterize the following for each study area:

- o The potential for a release from the site.
- o The toxicity, quantity, transport and fate of the substance in each media (ground water, surface water, soils and air).
- o The presence of an exposure pathway.
- o The likelihood of an impact on public health.

This Endangerment Assessment is divided into the Site Characterization (Section 2.0), Selection of Indicator Contaminants (Section 3.0), Exposure Assessment (Section 4.0), Human Intake Assessment (Section 5.0) and a characterization of the overall risk for each exposure scenario (Section 6.0). The detailed tables, figures and worksheets used in the Endangerment Assessment are contained in Appendix A through E. Summary tables are presented in the text.

SECTION 2.0

SITE CHARACTERIZATION

Information presented in this Section was obtained from various reports prepared for Jasco by Wahler Associates. Information obtained from other sources is referenced accordingly. Detailed figures and tables documenting this section are presented in Appendix A.

2.1 Site History and Description

Jasco is located at 1710 Villa Street in Mountain View, California (see Figure 2-1). Jasco has been in operation at this address, repackaging bulk chemicals into small containers and blending chemicals to produce proprietary products, since December 1976. The Jasco site encompasses 2.05 acres and is bordered on the northeast by Central Expressway and Southern Pacific Railroad, main line right-of-way and the Villa Mariposa apartment complex on the east. Single and multi-family dwellings along Higdon Avenue and Villa Street border the Jasco site to the west and south. Access to the site is gained from the south by way of Villa Street.

The site has historically been zoned industrial but was rezoned in December 1983 as residential. The property immediately southeast was previously occupied by Pacific Press and Peninsula Tube Bending. Prior to Jasco, the site was occupied by West Coast Doors, Inc.. West Coast Doors, Inc. used the site from May 1954 to June 1975 to manufacture and paint commercial and residential doors. The site was vacant from June 1975 to November 1976.

The actual plant, offices and storage areas are located at the rear of the property and occupy approximately 31,000 square feet of the total 89,300 square feet (2.05 acres). Approximately 66 percent of the site is vacant land. The facility is a combination of tilt-up concrete production area with a built-up roof. The production area is 4,000 ft² and completely explosion-proof wired and heavy-duty sprinklered. The finished goods area is 12,000 ft² and of butler-type construction with heavy-duty sprinklers and in-rack sprinklers for storage of flammable finished goods. Figure 2-2 presents the configuration of the Jasco site and layout of the facility.

2.2 Process Description

Jasco's production process involves repackaging of bulk chemicals into small containers and blending of chemicals to produce proprietary products. Bulk solvents are received in tankers and stored in eight underground tanks as shown in Figure 2-3. Filling of the underground tanks is done by gravity. Tanks

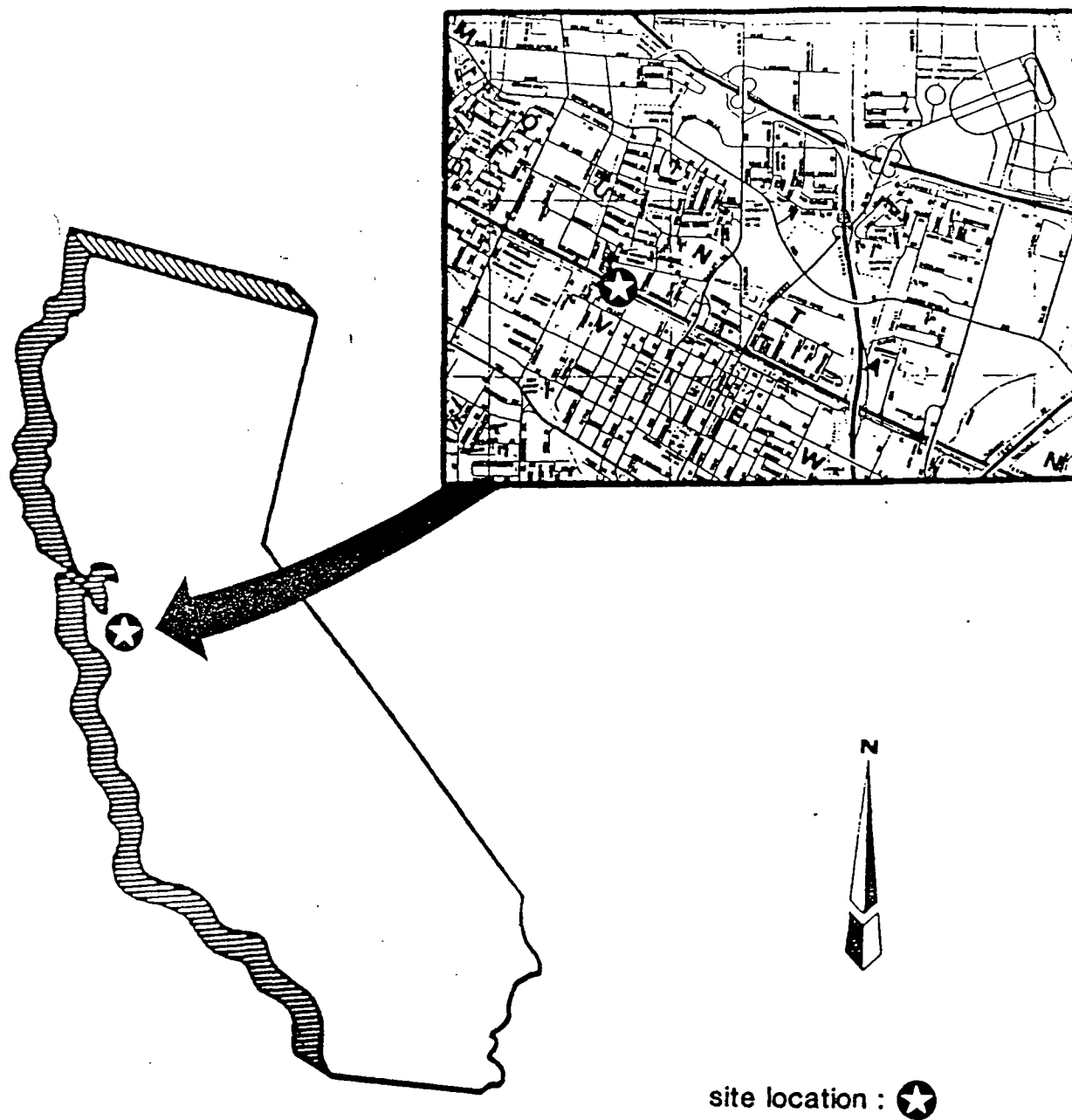
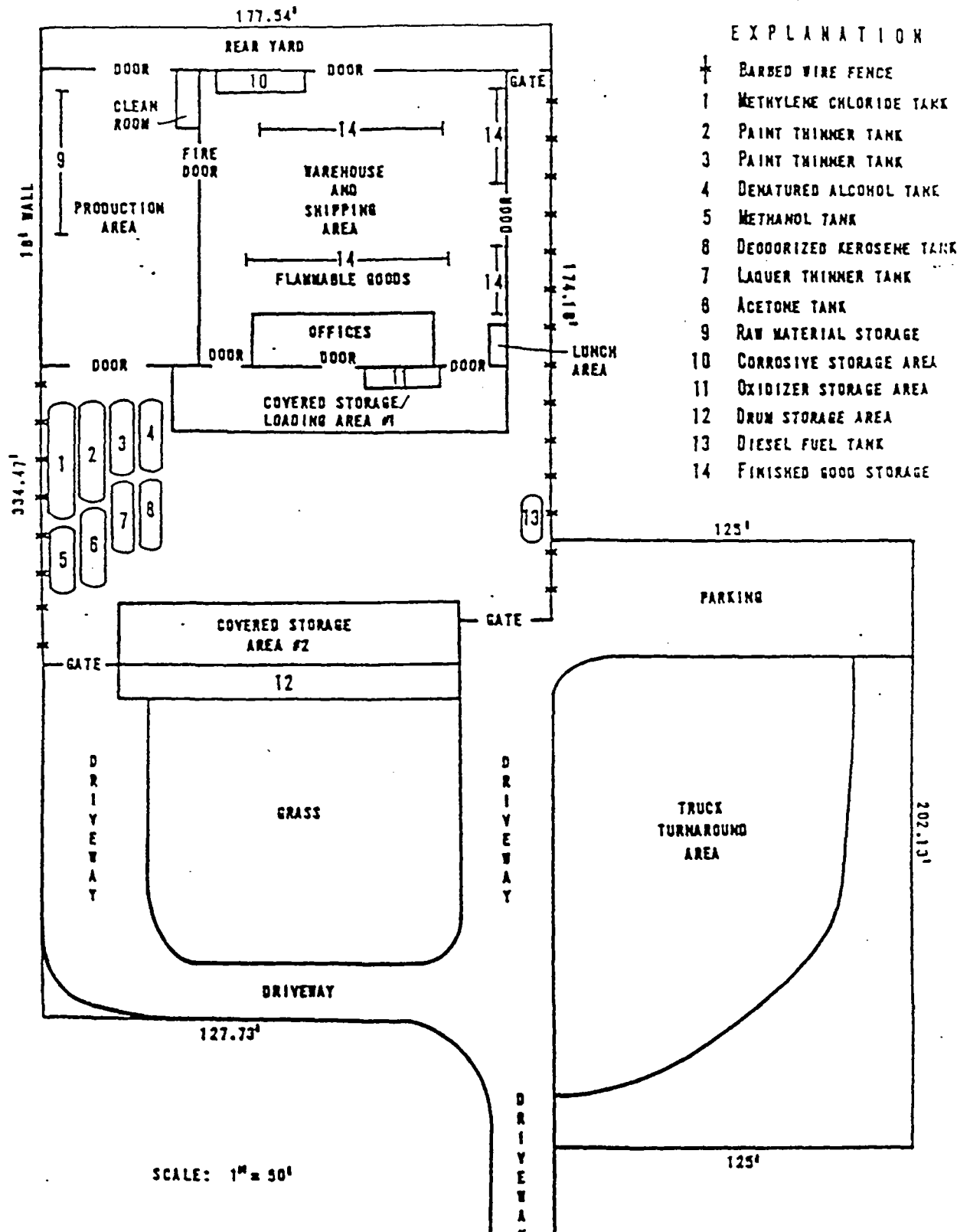


Figure 2-1 : Site Location - Jasco Chemical Corp. Site
Mountain View, CA.

**JE**

Source: Wahler Assoc.

2-2

are checked with a dip stick at least twice a week and is the basis for reordering additional solvents (Wahler Associates, Site Inspection Report, June 1987).

The physical characteristics of the loading and unloading areas are a combination of asphalt and concrete. Putty mixer, filling machine and all above-ground tanks are located in an area that has a reinforced concrete floor with the entire perimeter bermed so as to contain any uncontrolled release (Wahler Associates, Site Inspection Report, June 1987). Figure 2-3 also presents the locations of the bermed area, drains, drainage piping, dry wells, and the on-site sump.

2.2.1 Waste Management Practices

Prior to 1983, South Bay Chemical Co., and IT Transportation were used as the waste hauling companies. Manifest records are available only from 1980 to 1983. In 1983 production piping was altered in order to segregate compatible solvents. This allowed Jasco to accumulate line washings for reuse and eliminated the generation of waste (Wahler Associates, Site Inspection Report, June 1987).

In February 1987, a 55-gallon plastic drum containing methylene chloride was spilled on the concrete portion of the loading area. The spill was reported, and cleaned up by the use of an absorbant within 10 minutes. The spill site was inspected by the City of Mountain View Fire Department, Hazardous Chemical Section, and determined that none of the material had escaped from the site. No other spills of "clean" or waste product are known to have occurred (Wahler Associates, Site Inspection Report, June 1987). There are no known areas at the Jasco site that were or are used to dispose of any material.

2.3 Environmental Setting

The Jasco site is located in the San Francisco Bay area, in a major structural depression situated between the Santa Cruz Mountains on the west and the Hayward-Calaveras fault systems on the east. Locally, the site is bounded on the west by the Santa Cruz Mountains and the Berkeley Hills and Diablo Range on the north and east.

The Jasco site is located on a gently sloping alluvial plain which terminates at San Francisco Bay, approximately 4.5 miles to the north. Permanente Creek, a northward flowing, concrete-lined and channelized stream is located approximately 600 feet to the west-northwest of the site.

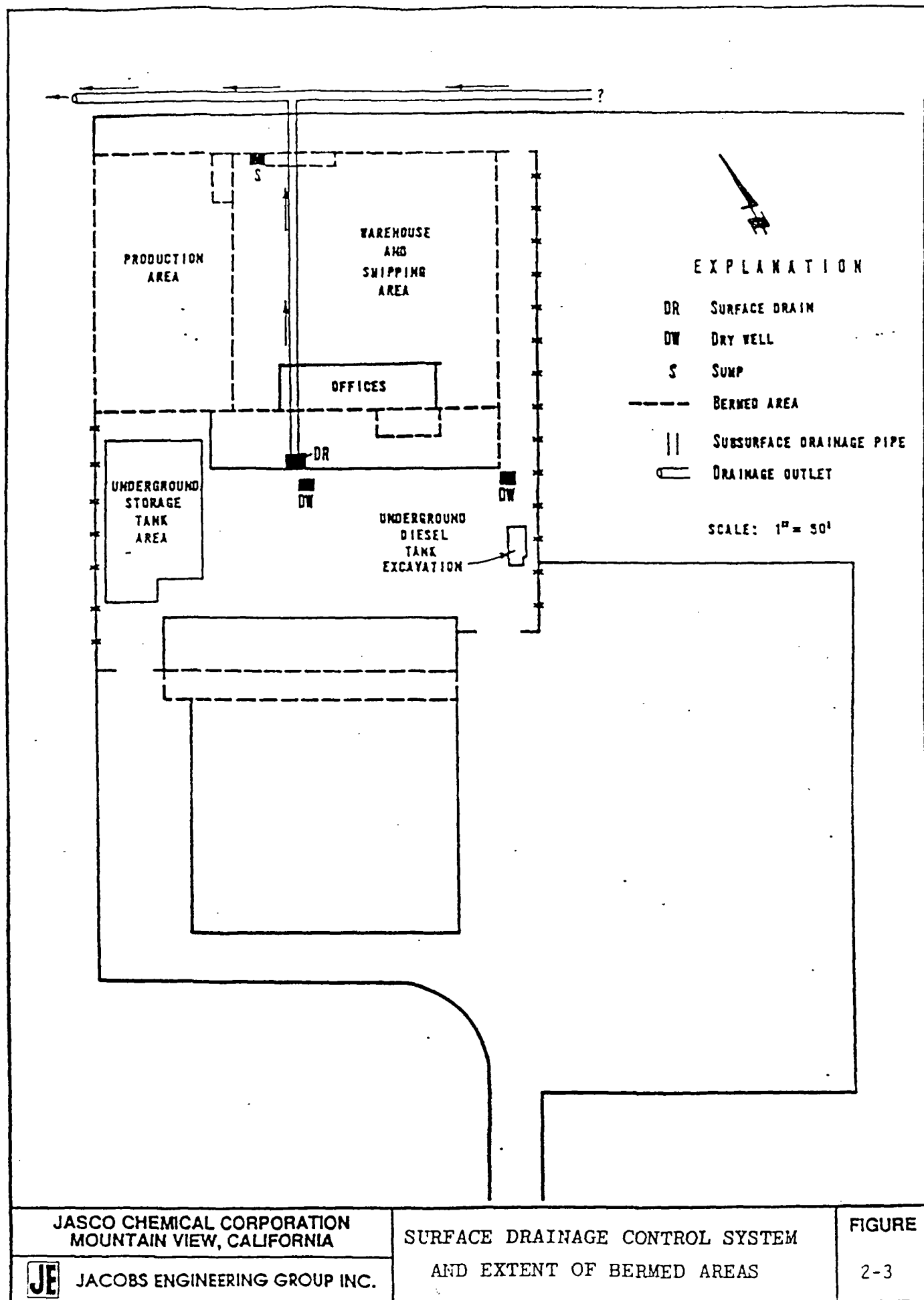
2.3.1 Hydrology

The Jasco site is at an approximate elevation of 60 feet above mean sea level. The surrounding topography slopes gently toward the north-northeast at approximately 100:1 (horizontal to vertical). Surface water on the developed portion of the site drains generally toward the north-northeast, toward the main building. Presently, a portion of the surface runoff flows into a drain which outlets off the northwest corner of the site, adjacent to the Southern Pacific Railroad Line. There, the discharged water ponds and evaporates and/or percolates into the soil. Surface runoff from the non-paved portions of the site is limited, as the site is virtually flat, non-landscaped, and has not developed a significant drainage network.

Permanente Creek, located approximately 600 feet northwest of the site, flows north-northeast toward San Francisco Bay (located 4.5 miles to the north). The creek is concrete-lined, channelized, and is used primarily for drainage and flood control.

2.3.2 Local Geology

The Jasco site is underlain by a thick sequence of unconsolidated sediments of Upper Plio-Pleistocene and Holocene ages. These sediments are considered to extend to a depth of 1,500 feet within the Santa Clara Valley basin, thinning southward to the base of the Santa Cruz Mountains. Benthic bay muds are not considered to form significant deposits in the ancestral Santa Clara Valley, due to the fact that the San Francisco Bay is considered by Helley (1979) not to have extended beyond its current shoreline. However, as sea level rose (transgression) into south San Francisco Bay, estuarine marshlands developed southward into the ancestral Santa Clara Valley. With the transgression of the marshes



landward, much of the (earlier) coarse-grained alluvial and fluvial deposits were buried by finer grained material. The estuarine deposits became laterally quite extensive during both transgressive and regressive events. Subsequently, in response to increased continental glaciation, the sea level of the ancestral San Francisco Bay dropped, and the previously deposited marsh deposits were regionally eroded, reworked, or buried by renewed alluvial and fluvial processes. Stratigraphically, this produced the general sequence of alternating fine and coarse grained materials.

Descriptions of regional geology can be found in the Endangerment Assessment for the Middlefield-Ellis-Whisman Site in Mountain View, California, prepared by Camp Dresser & McKee, Inc. by ICF-Clement, July 1, 1988. Modified excerpts from this document regarding the regional geology are located in Appendix A as Attachment 1.

2.3.3 Local Hydrogeology

The following information on the Jasco site hydrogeology is taken from a report prepared for Jasco by Wahler Associates, "Evaluation of Interim Remedial Alternatives," June 1988.

Three higher permeability aquifer units have been identified within the upper 70 feet section at and adjacent to the Jasco facility. The three higher permeability units have been designated the A-, B₁-, and B₂-aquifers. Figures A-1 and A-2 present geologic cross-sections prepared from borehole stratigraphic data. Cross-section locations are presented in Figure A-3.

The A-aquifer within the study area is encountered at depths ranging from 22.0 to 35.5 feet below ground surface. The thickness of the A-aquifer ranges from 3.0 to 13.5 feet. The bottom of the A-aquifer extends to depths of 28.0 to 42.7 feet below ground surface.

The B₁-aquifer is encountered at depths ranging from 42.0 to 47.5 feet below ground surface with the bottom of the aquifer at depths ranging from 54.5 to 57.5 feet. The thickness of the B₁-aquifer ranges from 7.5 to 11.2 feet. Analysis of pumping test data indicates that the A- and B₁-aquifers may be hydraulically connected within the study area. The B₁-aquifer is separated from the underlying B₂-aquifer by a low permeability unit designated as the B₁-B₂ aquitard.

Drilling logs indicate that the C-aquifer is approximately 150 feet below ground surface and is separated from the B-aquifer by the B-C aquitard. The B-C aquitard consists of two clay layers, 7.9 and 12.1 feet in thickness. The confining layers are separated by a 20-foot thick cemented gravel layer (refer to drillers logs, Appendix A) (Wahler Associates, Site Inspection Report, June 1987).

Based on the existing site data, a summary of the aquifer systems beneath the Jasco site is as follows:

Approximate Depths Below	
Zone	Ground Surface
A	22.0 - 35.5 feet
B ₁	44.5 - 56.0 feet
B ₂	*57.5 feet
C	150 feet

*Encountered in only one boring

Under non-pumping conditions, the movement of ground water within the A-aquifer is towards the northeast (N30xE) with an average gradient of 0.004 ft/ft. The direction of ground water flow within the B₁-aquifer is N15xE, with an average gradient of 0.003. Potentiometric surface maps of the A- and B₁-aquifers were prepared from data collected on October 7, 1987, during non-pumping conditions and are presented as Figure A-4 and A-5, respectively.

Currently, neither the A- nor B₁-aquifers are used for drinking water purposes in the vicinity of the Jasco site. The City of Mountain View operates several municipal wells in the general area which draw water from the C-aquifer.

A description of the regional hydrology is presented in Appendix A as Attachment 2.

2.3.4 Climatology

The San Francisco Bay Area has a characteristic Mediterranean climate with mild wet winters and warm dry summers. The South Bay Area exhibits considerable climatic variability compared to San Francisco with respect to temperature, cloudiness, and sunshine. The Santa Clara Valley lies in the path of winter storms which sweep inland from the North Pacific. Freezing temperatures and snow are extremely rare. Rainfall from the winter storms ranges from moderate to heavy. Climatic data from

the Mountain View Corporation Yard (period of record 1975 to present) and the Los Altos Fire Department weather station (period of record 1965 to present) are the most representative for the study area. According to these records, the average annual rainfall is about 14 inches. Over 75% of the total annual rainfall for this area occurs during the winter months of November through March. The average annual wind speed is approximately 6 to 7 mph, with slightly stronger winds occurring during the summer (ICF-Clement, July 1988).

The nearest pan evaporation station is the Alamitos station in southern San Jose. Based on data from this station, and allowing for seasonal variations in both precipitation and evaporation rates, Harding Lawson Associates (1987) has estimated that approximately eight inches of precipitation per year is potentially available for recharge to the local aquifers. However, recharge to the ground water is probably low due to the high degree of urbanization (ICF-Clement, July 1988).

2.4 Remedial Activities

On August 3, 1987, the California Regional Water Quality Control Board (CRWQCB) issued Jasco Clean-up and Abatement Order (CAO) Number 87-094. The CAO contained certain provisions for bringing the facility into compliance and a schedule for completion. The Jasco site has been proposed for inclusion on the Superfund National Priorities List (NPL) by the United States Environmental Protection Agency (EPA).

Preliminary ground water and soils investigations were performed at the Jasco site to determine the nature and extent of potential contamination. The results of the investigations revealed contamination of ground water and soils with chemicals of the same type used and/or stored at the Jasco facility. Subsequent investigations were performed to determine the source and spatial distribution of the contamination problem. Tables A-1 through A-4 in Appendix A presents summaries of the analytical results for ground water, surface water and soils. Reported low and high concentrations of contaminants are presented in Tables 2-1 through Table 2-3.

Jasco and their consultants have been performing ground water remediation activities since February 20, 1987. The concentration of chemicals detected within the vadose zone are confined to a limited area near the northwestern corner of the Jasco facility. The contamination is located in a drainage swale which receives storm water runoff via a subsurface drain pipe. The contamination extends from near-surface to a depth of 21.5 feet. The chemical contamination at this area consists mainly of volatile organic compounds (VOCs) such as paint thinner, methylene chloride, and 1,1,1-TCA. Remedial

TABLE 2-1
SUMMARY OF CONTAMINANTS DETECTED
IN GROUND WATER (A-AQUIFER)

Contaminant	<u>Highest Reported Value</u>		<u>Lowest Reported Value</u>	
	Concentration	Location	Concentration	Location
	mg/l		mg/l	
Acetone	1.80	V-2	0.003	V-8
Benzene	0.02	V-2	0.0019	V-6
Chloroethane	0.180	V-2	0.0031	V-1
1,1,-Dichloroethane	2.2	V-4	0.00069	V-8
1,1,-Dichloroethene	0.17	V-4	0.00065	V-8
1,2,-Dichloroethane	2.58	V-2	0.0010	V-3
Trans 1,2-Dichloroethene	0.013	V-2	0.0014	V-1
Ethylbenzene	0.057	V-2	0.0076	V-2
Methylene Chloride	142.0	V-2	0.0014	V-1
Methyl Ethyl Ketone	0.15	V-2	0.004	V-1
Pentachlorophenol	0.05	V-3	0.0002	V-1
Tetrachloroethylene	0.008	V-2	0.006	V-2
Toluene	0.360	V-2	0.0038	V-4
1,1,1-Trichloroethane	2.04	V-2	0.0018	V-3
Trichloroethene	0.019	V-2	0.0022	V-2
Vinyl Chloride	0.016	V-4	0.00068	V-3
Xylene	0.062	V-2	0.008	V-3

TABLE 2-2
SUMMARY OF CONTAMINANTS DETECTED
IN SURFACE WATER

Contaminant	<u>Highest Reported Value</u>		<u>Lowest Reported Value</u>	
	Concentration mg/l	Location	Concentration mg/l	Location
Acetone	0.290	Ponded Water/ Drainage Swale	ND ⁽¹⁾	
Benzene	ND		ND	
Chloroethane	ND		ND	
1,1,-Dichloroethane	.056	Ponded Water/ Drainage Swale	0.0039	Discharge Pipe
1,1,-Dichloroethene	ND		ND	
1,2,-Dichloroethane	ND		ND	
Trans 1,2-Dichloroethene	ND		ND	
Ethylbenzene	ND		ND	
Methylene Chloride	1.30	Ponded Water/ Drainage Swale	0.014	Roof Downspout
Methyl Ethyl Ketone	ND		ND	
Pentachlorophenol	0.200	Ponded Water/ Drainage Swale	ND ⁽²⁾	
Tetrachloroethylene	ND		ND	
Toluene	ND		ND	
1,1,1-Trichloroethane	0.700	Ponded Water/ Drainage Swale	0.0130	Ponded Water/ Drainage Swale
Trichloroethene	ND		ND	
Vinyl Chloride	ND		ND	
Xylene	0.0098	Ponded Water/ Drainage Swale	ND	

(1) Not detected.

(2) Only one value reported.

TABLE 2-3
SUMMARY OF CONTAMINANTS DETECTED
IN SOILS

Contaminant	<u>Highest Reported Value</u>		<u>Lowest Reported Value</u>	
	Concentration mg/l	Location	Concentration mg/l	Location
Acetone	278.0	Drainage Swale	1.1	Drainage Swale
Benzene	3.0	Drainage Swale	ND(1)	Drainage Swale
Chloroethane	---(2)	---	---	---
1,1,-Dichloroethane	27.0	Drainage Swale	0.34	Drainage Swale
1,1,-Dichloroethene	13.0	Drainage Swale	ND	Drainage Swale
1,2,-Dichloroethane	3.98	Drainage Swale	ND	Drainage Swale
Trans 1,2-Dichloroethene	4.80	Drainage Swale	ND	Drainage Swale
Ethylbenzene	170.0	Drainage Swale	---	---
Methylene Chloride	3400	Drainage Swale	0.99	Drainage Swale
Methyl Ethyl Ketone	ND	Drainage Swale	ND	Drainage Swale
Pentachlorophenol	0.20	0.15ft Well V-2	0.009	20-35ft Well V-2
Tetrachloroethylene	16.0	Drainage Swale	.0067	Drainage Swale
Toluene	1700.0	Drainage Swale	61.0	Drainage Swale
1,1,1-Trichloroethane	22.0	Drainage Swale	0.11	Drainage Swale
Trichloroethene	490.0	Drainage Swale	0.088	Drainage Swale
Vinyl Chloride	ND	Drainage Swale	ND	Drainage Swale
Xylene	91.0	Drainage Swale	1.70	Drainage Swale

(1) Not Detected: Applies to contaminants where only one value was reported.

(2) Not Analyzed.

activities have included excavation of soils from the contaminated area. Figure A-6 in Appendix A presents a summary of chemical analysis results in soils at the drainage swale.

The highest chemical concentration in the A-aquifer has been detected at the northwest corner of the Jasco site, adjacent to the drainage swale where concentrations of chemicals have been detected within the vadose zone soils. Chemicals in the A-aquifer have migrated down-gradient as far as the northern shoulder of the Central Expressway. Isoconcentration maps showing the distribution of chemical concentrations within the A-aquifer are presented as Figures A-7 through A-10. The concentration of chemicals detected within the B₁-aquifer (see Figure A-11) are below DOHS recommended action levels.

Contamination of the A and B₁-aquifers from other sources in the area have been documented. The contaminated sites located down-gradient or cross-gradient from the Jasco site include: the Teledyne and Spectra Physics sites located 0.88 miles north of the site; the CTS Printex site, located 1.36 miles north of Jasco; the "Mountain View 5" sites located 1.50 miles east of Jasco; Hewlett Packard, Logue Avenue site located, 2.20 miles east of the Jasco site, and Moffett Field Naval Air Station, located 2.27 miles northeast of Jasco. The Hillview-Elanor plume is located up-gradient and approximately 1.72 miles southwest of Jasco (Wahler Associates, Site Inspection Report, June 1987).

Although this Endangerment Assessment assumes a no remediation scenario, the remediation processes that have been previously described cannot be ignored. These processes have significantly altered the collected and evaluated data, and therefore a "true" no remediation condition does not exist.

SECTION 3.0

INDICATOR CONTAMINANT SELECTION

3.1 Introduction

To evaluate the potential impacts that the Jasco site may have on human health, indicator contaminants were selected from chemical compounds identified in ground water, surface water, and soil samples obtained during the remedial investigation. In order to focus the assessment on those contaminants which potentially pose the highest risk, the contaminants were evaluated with respect to their relative toxicity, mobility, prevalence on-site and persistence. From this data, a subset of indicator chemicals was developed. This section explains the approach used to identify the contaminants on-site and the methodology used to adjust and finalize the indicator chemical list. Tables and work sheets showing the indicator containment selection process are presented in Appendix B.

3.2 Indicator Contaminant Selection Methodology

The indicator contaminant selection process involved a review of site characterization data. These include the Preliminary Ground Water Investigation Report (Questa Engineering Corp., 1984), Phase I Hydrogeological Investigation Report (Wahler Associates, 1987) and Surface Water and Soil Sampling Investigation Report (Wahler Associates 1988) as well as chemical-specific physical and toxicological data. The toxicity and physical property data were obtained from the Superfund Public Health Evaluated Manual (SPHEM) along with the appropriate methodology for indicator contaminant selection (USEPA 1986).

The selection of the indicator contaminants focuses on the toxicological properties of the contaminants detected in ground water, surface water and soil. The final list of the indicator contaminants provides a cross section of carcinogenic and non-carcinogenic contaminants that are representative of the most toxic, persistent and mobile contaminants identified through monitoring.

The indicator contaminants were selected from a list of contaminants known to be present at the Jasco site. This list is presented in Table B-1 and was developed from a review of historical documents and available site characterization data. From this list the initial indicator contaminants were selected. Aliphatic hydrocarbon mixtures such as paint thinner and lacquer thinner were not evaluated in the indicator scoring process except when the components of these compounds were analyzed for separately. Gasoline was not represented in the indicator scoring process as it contains aromatic hydrocarbons such as, ethylbenzene and xylene. Individual components were sometimes analyzed for

and when available, the data were considered in the scoring process. Contaminants that were infrequently detected during a series of testing programs and/or at low concentrations were not considered representative of site conditions, therefore they were not included on the initial indicator contaminant list.

Concentrations of the contaminants were identified as maximum and representative (mean) concentrations observed during remedial investigation activities. Toxicity data for each contaminant were compiled and reviewed.

Indicator scores for each contaminant were calculated by multiplying the maximum and representative concentrations by the toxicity constant for the specific environmental media. Indicator scores and factors related to environmental mobility and persistence and other chemical and physical characteristics were compiled for each contaminant. The final selection of indicator contaminants was made on the basis of the indicator scores and environmental mobility and persistence.

The specific selection process for indicator chemicals is described in SPHEM (USEPA 1988). Each step in the process is documented in Tables B-1 through B-7. The final indicator contaminants selected include potential carcinogens and non-carcinogens and contaminants exhibiting both qualities. Table 3-1 presents a list of the final indicator contaminants selected.

3.3 Health Effects of Indicator Contaminants

The following presents a summary of the adverse health effects associated with exposure to the individual indicator contaminants. Extensive discussions of the toxicological properties and regulator criteria are presented in Appendix B as Attachment 1.

1,2-Dichloroethane

Human data on subchronic oral toxicity of 1,2-Dichloroethane (1,2-DCA) are not available, and the only available animal data provide inconclusive evidence that effects on the immunological systems of rats and mice are due entirely to 1,2-DCA. However, subchronic inhalation studies in animals have identified rabbits as the most resistant and guinea pigs as the most sensitive to the adverse effects of 1,2-DCA (Spencer et al. 1951). Large doses of 1,2-DCA given to rats have led to high mortality rate in males and females due to toxic, not carcinogenic, effects (USEPA 1984). Chronic occupational exposures to 1,2 DCA have been documented. In most cases inhalation of 1,2-DCA has produced

TABLE 3-1
FINAL INDICATOR CONTAMINANT LIST

Indicator Contaminant	Carcinogen	Non-Carcinogen	Ranking(1)	
			Potential Carcinogens	Non- Carcinogens
1,2-Dichloroethane	X		1	5
1,1-Dichloroethene	X	X	3	2
Trichloroethene	X		4	2
Vinyl Chloride	X		5	6
Benzene	X		6	10
Tetrachloroethylene	X	X	7	16
Methylene chloride	X	X	2	3
1,1-Dichloroethane		X	---	4
Pentachlorophenol		X	---	8

(1) Ranked by maximum indicator score values.

symptoms such as nausea, vomiting, anorexia, irritation of the eyes and respiratory tract (USEPA 1984c).

Animal bioassays provide significant data on the carcinogenic potential of 1,2-DCA. In a 1978 NCI Study it was found that oral doses of 1,2-DCA given to rats produce various tumors in male and female rats (USEPA 1984c). No data are available on the teratogenic effects of oral or inhaled 1,2-DCA in humans or of oral 1,2-DCA in animals. Animal data on inhaled 1,2-DCA have been inconclusive (USEPA 1984c).

1,1-Dichloroethylene

1,1-Dichloroethylene (1,1-DCE) is commonly known as vinylidene chloride. Animal studies, conducted since the early 1960s, have provided almost all of the information from which human effects can be assessed. Subchronic inhalation data have revealed that continuous exposure to concentrations up to 395 mg/m³ result primarily in liver and kidney damage in rats, guinea pigs and monkeys. High exposure to 1,1-DCE in drinking water appears to produce adverse liver changes in male and female rats (USEPA 1984d).

Animal bioassays with respect to oral treatment of rats and mice with 1,1-DCE have not found evidence of carcinogenicity. However, inhalation studies on rats and mice have demonstrated a possible relationship between mammary tumors in both species and kidney tumors in male mice (Maltoni et al. 1980). Oral studies on the teratogenicity and reproductive effects have been inconclusive, whilst inhalation studies on rats have found fetotoxic effects (Murray et al. 1979).

Trichloroethylene

Inhalation exposure to trichloroethylene (TCE) 2900 ppm has produced lethality in humans and a single oral dose of 7000 mg/kg has also been reported to be lethal to humans (ATSDR 1988b). The primary target organ effected by inhalation exposure is the central nervous system (ATSDR 1988b). Inhalation studies in rats and mice found acute and intermediate duration exposure have produced liver enlargement, increased kidney weight and some liver cell alterations (Kjellstrand et al. 1983). Animal oral studies have suggested adverse effects to the immune system (Tacker et al 1982).

Human studies on the carcinogenicity of TCE are reported in the literature for inhalation exposure, but not oral exposure. In particular, several epidemiological studies completed between 1978 and 1985 found significant excesses of cancer above background with the exception of bladder cancer and

lymphoma in one study (ATSDR 1988b), there is inconclusive data available on the developmental toxicity of oral or inhaled TCE to humans. Inhalation studies in rats have found that TCE is fetotoxic, decreases fetal weight and increases litter resorption. Oral exposures to TCE have shown alteration in male rat mating behavior and reduced prenatal survival rate in mice (ATSDR 1988b).

Vinyl Chloride

Inhalation exposure to vinyl chloride has been reported as lethal in high (unquantified) concentrations. Animal studies on rats and mice have indicated that both inhalation and oral exposure to vinyl chloride decreases longevity (ATSDR 1988).

Occupational epidemiology has led to the association of vinyl chloride exposure via inhalation, with various tumors including liver, brain and lung (ATSDR 1988b). Studies in rats and mice indicate that the carcinogenicity of vinyl chloride is manifested as an increased incidence in liver angiosarcomas in rats and lung cancer in mice even at low level inhalation exposures such as 50 ppb (ATSDR 1988c). Human data on inhalation exposures show that there may be an increased likelihood of fetal loss, and alterations in sexual function in both sexes (ATSDR 1988c).

Benzene

Accidental inhalation of benzene by humans has led to limited information on its lethality. It has been suggested that a level of 20,000 ppm for 5-10 minutes (continuous exposure) is an acutely lethal dose (Sandmyer 1981). Studies on rats suggest benzene inhalation has a low acute toxicity. There is a wide range of oral lethal doses reported for humans, the highest being 428 mg/kg (ATSDR 1987). Oral and inhalation studies on rats and mice have led to the conclusion that the systems most affected by benzene are primarily the hematopoietic and immune systems, and in some instances, the nervous system (ATSDR 1987).

Several epidemiological studies have been conducted since 1978 and these have been the basis for the assessment of the risk of leukemia from benzene exposure (ATSDR 1987). Inhalation exposure data revealed a unit risk of 2.6×10^{-2} for leukemia. Benzene has been found to be potentially fetotoxic to mice and rabbits, with effects such as decreased fetal weight evident when exposed to approximately 155 ppm via inhalation (ATSDR 1987). No data are available on oral or dermal exposure routes and no human data are available.

Tetrachloroethylene

Inhalation studies on the lethality of tetrachloroethylene (PCE) in rats and mice have indicated decreased longevity in both species, at high concentrations (1600-1750 ppm) over extended periods of exposure (14 days-13weeks) (ATSDR 1988c). The primary target organs effected by PCE exposure are the central nervous system, liver and kidney.

Inhalation exposure to PCE has been found to result in an elevated mononuclear cell leukemia rate in rats of both sexes and an elevated hepatocellular carcinoma incidence in mice of both sexes (NTP 1986). Animal data on the results of inhalation exposure to PCE showed mice to have an increased number of embryotoxic effects such as split sternabrae and an increased percentage of fetal resorption (ATSDR 1988a).

Methylene Chloride

The only animal study on oral subchronic exposure to animals defined a no-observed-effect-level of 12.5 mg/kg/day in rats (USEPA 1983). Subchronic inhalation exposure to methylene chloride in rats, mice and monkeys appears to be associated with liver and kidney lesions (USEPA 1983). Reported occupational exposure to methyl chloride involved symptoms ranging from mild light headedness to toxic incephalosia following five years of direct contact with the compound daily. A 1983 study (Ott et al.) found no increase in mortality, in men and women, due to cardiopulmonary disease or malignant neoplasm associated with methyl chloride exposure.

Oral exposure bioassays on both rats and mice have found methyl chloride to produce a small but significant increase in the incidence of hepatocellular tumors leading to EPA to conclude the compound has "borderline carcinogenicity" (USEPA 1984f). Animal studies on rats and mice have found significant reductions in fetal body weight and some accelerated bone development in the respective species (USEPA 1984f).

1,1-Dichloroethane

Very few studies on animals have been completed, but inhalation exposures of 1000 ppm to cats revealed renal alterations when exposure continued for five days per week for thirteen weeks. Oral exposure studies in rats have found that sustained high levels of exposure to 1,1-Dichloroethane

(1,1-DCA) produces significant increase in mortality rate and associated renal damage (USEPA 1984b).

Bioassays conducted on rats have found significant increases in mammary adenocarcinoma incidence following chronic oral exposure to 1,1-DCA (USEPA 1984b). However other carcinogenicity tests have failed to find a relationship between 1,1-DCA and tumor incidence (USEPA 1984b). Studies on rats exposed to 1,1-DCA during gestation, via inhalation, show significant alteration in bone ossification of the offspring (Schwetter et al. 1974).

Pentachlorophenol

Reports describing PCP poisoning in workers or from improper use of PCP-containing products in the home by individuals indicates that brief exposure to high levels of PCP can cause adverse health effects on the liver, kidney, skin, blood, lungs, nervous system, gastrointestinal tract, and death. Long-term exposure to lower levels of PCP can result in damage to liver, blood and nervous system, but the routes of exposure (dermal, oral, inhalation) have not been separated.

There is no convincing evidence from epidemiological studies that indicate that PCP produces cancer in humans. Case reports suggest a possible association between cancer (Hodgkin's disease, soft-tissue sarcoma and acute leukemia) and occupational exposure to technical PCP. (Fingerhut et al., 1984; Greene et al., 1978; Roberts, 1983). However in all these cases the possibility of concurrent exposure to other toxic substances cannot be excluded.

Evidence does exist from animal studies to consider PCP a probable human carcinogen. The best evidence comes from a recent study conducted by the National Toxicology Program (NTP, 1988). The study compared the carcinogenic effects of two PCP preparations, TG-penta and Dowicide EC-7, by oral exposure to mice for two years. EC-7 contained lower levels of the toxic impurities debenzo-p-dioxins and debenzofurans. The incidence of hepatocellular adenomas/carcinomas, adrenal medullary pheochromocytomas (benign and malignant) and hemangiomas/hemangiosarcomas (predominantly in the spleen and liver) was significantly increased in both studies in one or both sexes. In other carcinogenicity studies of various polychlorinated debenzo-p-dioxins only hepatocellular tumors were seen, therefore it can be concluded the PCP itself possesses oncogenic activity.

SECTION 4.0

EXPOSURE ASSESSMENT

4.1 Introduction

The purpose of the Exposure Assessment section of the Jasco Endangerment Assessment is to determine the extent to which the populations surrounding the Jasco site may be exposed to the contaminants released into the environment as a result of past and current Jasco depositions. To accomplish this objective, the following items were evaluated.

- o Study area characterization
- o Potential exposure medias
- o Potential exposure pathways

Once complete pathways were determined, exposure point concentrations of indicator contaminants were determined.

4.2 Study Area Characterization

The study area for this Endangerment Assessment encompasses approximately 138 acres, bounded by Mariposa Avenue on the east, Euscala Avenue on the west, Highway 101 on the north and California Street on the south (see Figure 4-1). The study area is not related to the extent of the Jasco site impact and actually encompasses an area larger than the impacts identified in the remedial investigation. Existing land-uses for the Jasco study area were identified by a field survey. Although the study area primarily supports residential areas, an industrial area and commercial area does exist. Residential areas comprise approximately 90% of the study area. Current City of Mountain View ordinance designate the entire study area as residential zoning.

The Jasco site is the only remaining industrial complex in the study area. Jasco's conditional use permit from the rezoning requires that the company evacuate its present location by 1992. The Jasco site comprises approximately 1.5% of the total study area. One business office complex is located within the study area. The complex is located southeast of Jasco and occupies approximately 8% of the total study area.

The following population data was obtained from information obtained in an Endangerment Assessment report for the Middle-Ellis-Whisman (MEW) site, located approximately 1.5 miles east of the Jasco study area. The report included population data within a three mile radius of the MEW site which includes the Jasco study area. While data from the Endangerment Assessment report

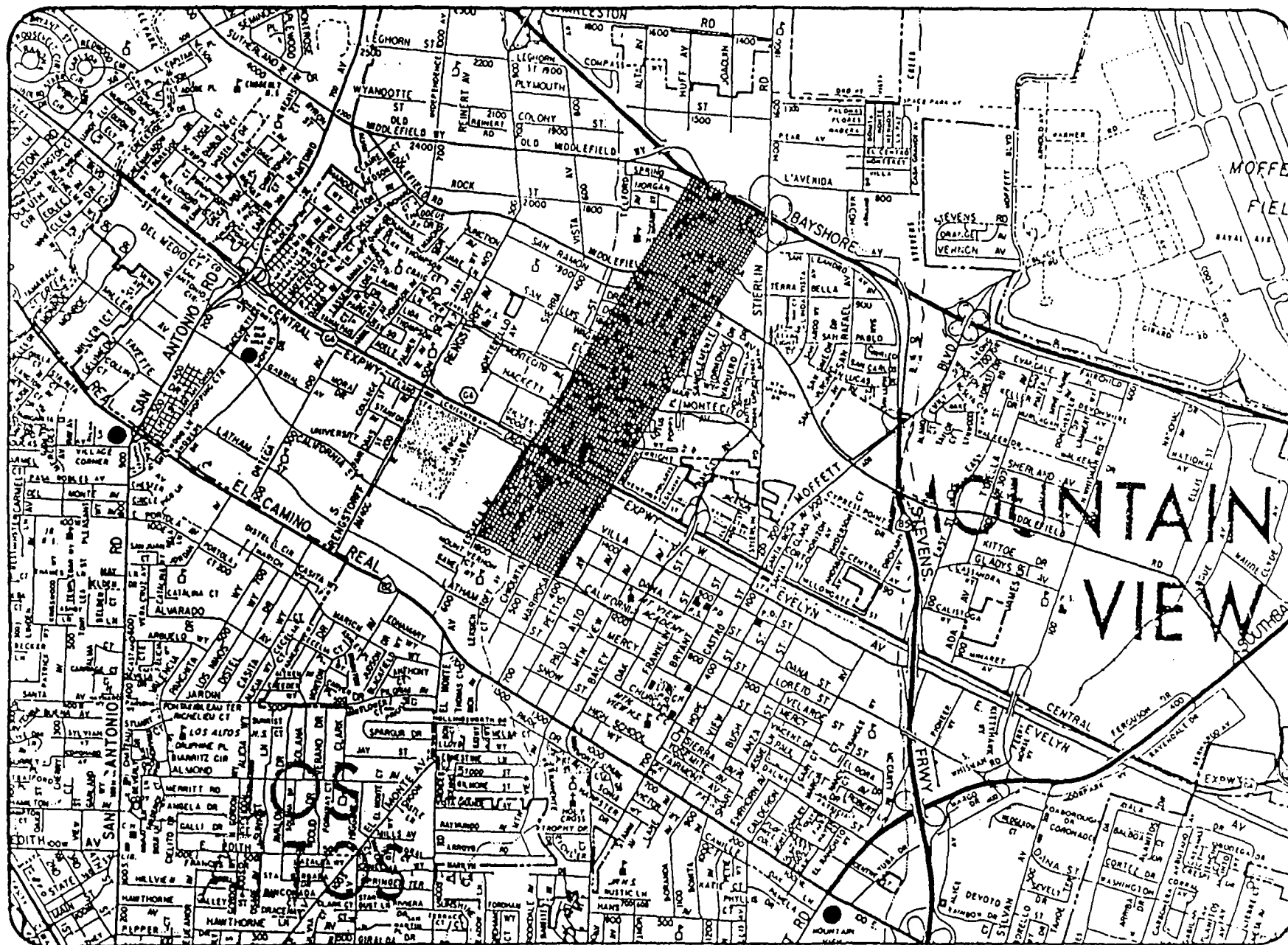


Figure 4-1
Jasco Endangerment Assessment
Study Area

encompasses an area larger than the Jasco study area, the data can be used to evaluate general population trends.

The current population within the Jasco study area is approximately 900, with an annual growth rate of 0.2%. The current average family size is three with no major changes forecast for 1992. The current median and average ages are 36.6 and 38.6, respectively. Adults over 44 years of age comprise 53.4% of the population, with adults in the 30-40 year range comprising 30% of the population. Most children are in the 5-11 year old range with 7% of the total population, followed by the 0-4 year old range with 5% of the total population, and the 12-16 year old range with 4.6% of the total population.

4.3 Potential Exposure Media

At the Jasco site, contaminants have been detected in surface waters, ground water, and soils. Since the indicator contaminants have been found in these media, they are suspected of contributing to the potential exposure of a receptor. The following sections provide insights and evaluation of the particular medias and qualitatively address the potential exposure routes.

Information to date indicates that the primary concern at the Jasco site is the potential for, or existence of, ground water contamination. Because of this, special emphasis is placed on describing and evaluating the ground water pathway.

4.3.1 Ground Water Exposure Media

Ground water is regulated by the Santa Clara Valley Water District (SCVWD) with a fee charged for ground water withdrawal. Neither the A or B-aquifers are currently used for drinking water purposes in the vicinity of Jasco. SCVWD records indicate that there may be old agricultural wells in existence within one mile of the Jasco site. However, a large percentage of the agricultural and private wells in Mountain View have been abandoned under the supervision of the SCVWD. Currently agricultural uses of water are practically non-existent in Mountain View.

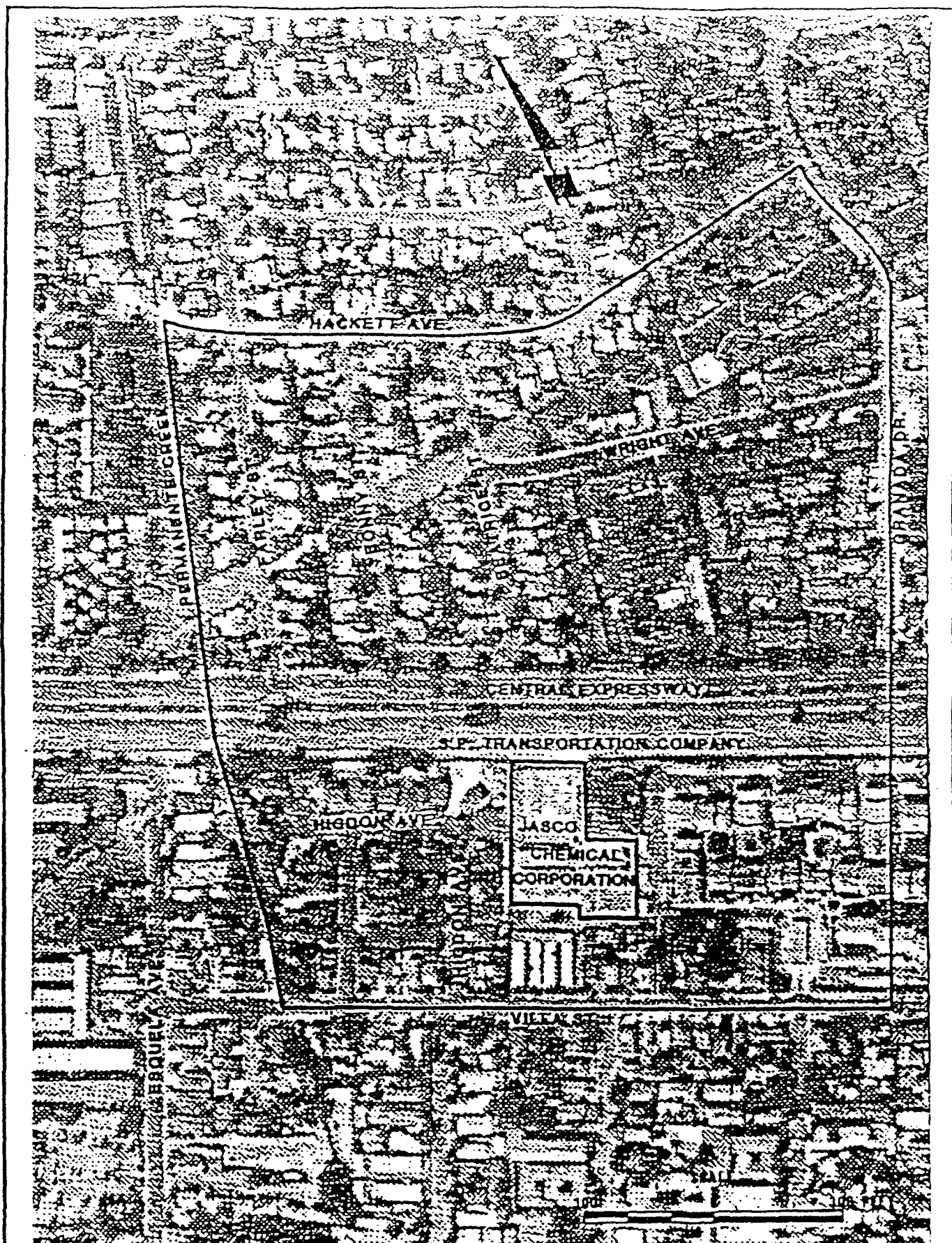
It does not appear that contaminants will migrate to any of the City of Mountain View's municipal water supply wells. This is based on the current locations of these wells with respect to the contaminant plume trend, regional hydraulic gradients, and hydrostratigraphic constraints. The municipal water supply wells are completed within the C-aquifer which occurs at a depth of approximately 150 feet below the surface and is separated from the A-aquifer by several aquitard units of which the most noteworthy is the B-C aquitard. The B-C aquitard has never been encountered at

the Jasco site due to the lack of any deep exploratory drilling. The B-C aquitard has been investigated thoroughly by Harding Lawson Associates for a study area located approximately two miles east of the Jasco site. Harding Lawson indicates the B-C aquitard to be generally 20-40 feet thick, consisting predominantly of stiff silty clay with occasional sand lenses. Therefore, the C-aquifer is effectively isolated from the overlying aquifers by the B-C aquitard with the exception of where local conduits may provide hydraulic interconnection. (Harding Lawson Associates, 1987).

A potential conduits investigation was performed by Wahler Associates for Jasco to satisfy the requirements of Cleanup and Abatement Order (CA0) No. 87-094. The objective of the investigation was to assess the potential for contaminants to migrate from shallow to deeper ground water resources via unsealed or improperly sealed wells with multiple perforations or annular gravel packs which may be in contact with contaminated ground water. The investigation also included an assessment of the potential for horizontal migration of contaminants via activities resulting from residential and industrial development such as utilities excavations, storm sewers, and the Hetch-Hetchy aqueduct. The conduit inventory region is bounded on the south by Villa Street; on the north by Hackett Avenue; on the west by Permanente Creek; and on the east by Granada Drive (see Figure 4-2). The investigation indicated a total of five active, inactive and decommissioned water producing wells within the inventory region (see Figure 4-3). One of the wells (F01), is the Jasco A-aquifer monitoring well V-4. The SCVWD indicated two other wells (G03 and G04) were decommissioned in 1966, with the method of decommissioning unknown. These wells are located on the eastern border of the inventory region and should not be affected by the Jasco plume. The two additional wells seen on Figure 4-3 (D#1 and C#2) were identified by aerial photo interpretation as part of the South Bay Multi-Site Cooperative Agreement Investigation. A field check by Wahler personnel failed to locate these wells. The investigators indicated that a tool shed near the location of well C#2 and a cement encased housing for intake/release valves associated with the Hetch-Hetchy aqueduct near the location of well D#1 may have been mistakenly identified as well pump houses. The investigators indicated there were no other water producing wells located within the inventory region. The only monitoring wells located in the inventory region are the Jasco site monitoring wells.

Contaminant Release and Transport Mechanisms in Ground Water

Ground water flow and contaminant transport follow complex patterns in alluvial/fluvial sediments such as those of the Santa Clara Valley. This is primarily due to the variations in the materials and physiochemical interactions between subsurface materials and the chemical solutes in ground water.



JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA

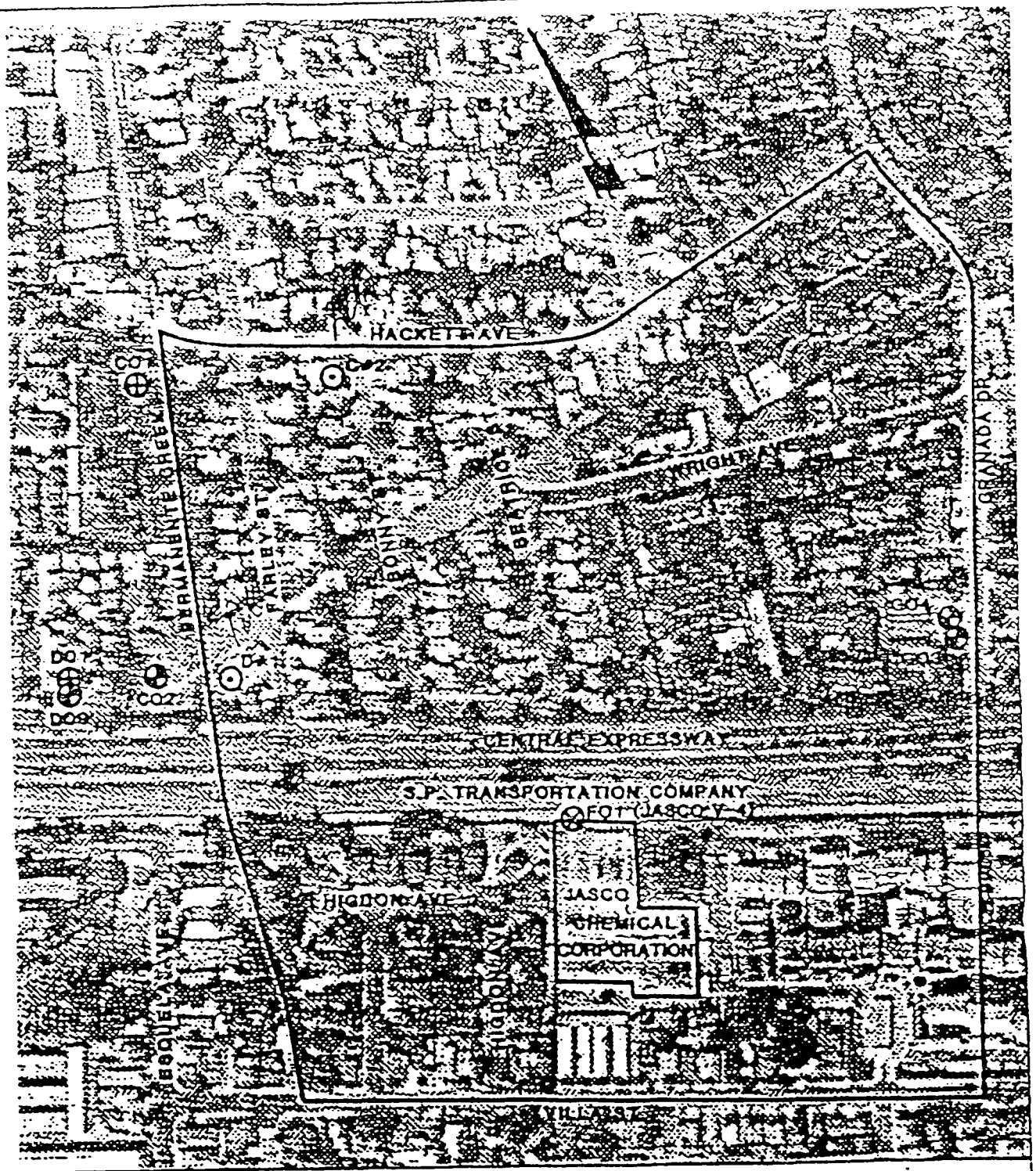


JACOBS ENGINEERING GROUP INC.

CONDUIT INVENTORY REGION

Source: Wahler Assoc.

FIGURE
4-2



EXPLANATION



CONQUIT INVENTORY REGION



DESTROYED DOMESTIC WELL



WELL IDENTIFIED BY AIR-PHOTO
INTERPRETATION



ACTIVE INDUSTRIAL WELL



DESTROYED WELL - USE UNKNOWN

300 0 300 FEET

JASCO CHEMICAL CORPORATION
MOUNTAIN VIEW, CALIFORNIA



JACOBS ENGINEERING GROUP INC.

PRELIMINARY WELL IDENTIFICATION
SUMMARY

(NOT INCLUDING MONITORING WELLS)

FIGURE

4-3

Source: Wahler Assoc.

Hydraulic conductivity is a measure of the relative ability of an aquifer to transmit water (also commonly known as coefficient of permeability). The permeability of sand and gravel is typically several orders of magnitude higher than that of silt and clay. Therefore, lenses and layers of sand and gravel are a preferential pathway for ground water flow and contaminant transport, with silt and clay layers serving as barriers to this flow (confining layers). In most cases, the majority of ground water flow is horizontal, following the subhorizontal orientation of the high-permeability layers. Some vertical flow occurs through the confining layers separating permeable zones with different hydraulic heads.

Detailed studies of the hydraulic characteristics of alluvial sediments demonstrate that estimates of contaminant flow based on measured hydraulic conductivities of specific units are often unreliable. Contaminant migration in complex alluvial environments are best defined by sampling and analysis of monitoring wells.

Contaminant Migration

The dominant contaminant transport mechanisms are advection, dispersion and diffusion. Sorptive phenomena results in the retardation of contaminants. Further reductions in contaminant concentrations result from volatilization and microbial degradation (Ali, no date).

Advection is the process of physical transport of contaminants by the bulk movement of ground water. Dispersion refers to the mechanical spreading and mixing that occurs as ground water follows tortuous paths in randomly distributed sand and clay layers. Diffusion results from the movement of areas of high contaminant concentration to areas of less concentration by molecular forces. Sorption phenomena encompasses both adsorption and absorption processes. Adsorption is the adhesion of chemical molecules to particulate surface, while absorption connotes incorporating chemical molecules within the molecular structure of the subsurface materials.

The migration of volatile contaminants is proportional to the ground water velocity, modified by dispersion, diffusion, sorption, and volatilization effects. Dispersion and diffusion phenomena cause contaminants to spread, so that the margins of contaminant plumes are gradational rather than abrupt.

Sorption generally results in the retardation of contaminants in alluvial sediments. This may be due to clayey soils having a significant sorptive capacity for synthetic volatile organic compounds (VOCs). Concurrently, diffusion and refraction at interfaces between layers of high and low permeability are the main mechanisms of contaminant dissemination in lower permeability layers (Gilham and Cherry, 1982; Hubbert, 1940).

At the interface between the high and low permeability layers, the processes of diffusion and refraction dominate contaminant migration. At macro- and micro-scales, the principal component of ground water and contaminant flow in sandy layers is largely horizontal. In clayey layers, contaminant migration is largely vertical, occurring mainly by diffusion and enhanced where refraction occurs.

In coarse-grained materials, contaminant dispersion by molecular diffusion is considerably less than dispersion by advection. In the lower-permeability materials, dispersion of contaminants within a complex flow system occurs primarily through molecular diffusion. The driving mechanism for molecular diffusion is the continually changing contaminant concentration contrasts between relatively rapid moving water in the sandy layers, and the lower velocity water in the clayey layers (Gilham and Cherry, 1982).

The extent to which a contaminant advances within the lower-permeability layers depends largely on the thickness of those layers, their permeability, contaminant concentration contrast and time. This implies that higher concentrations of contaminants should be found at the boundaries of the low-permeability layers and concentrations should decrease inward until the layer reaches equilibrium (Gilham and Cherry, 1982).

Refraction of ground water flowlines occurs at the interface of two formations of differing hydraulic conductivity. The angle of refraction is proportional to the contrast in hydraulic conductivity, i.e., the greater the contrast in hydraulic conductivity, the larger the angle of refraction (Freeze and Cherry, 1979).

In summary, flowlines prefer to use high-permeability formations as conduits, and try to traverse low-permeability formations by the shortest route. In aquifer-aquitard systems with permeability contrasts of two orders of magnitude or more, flowlines tend to become almost horizontal in aquifers and almost vertical in aquitards (Freeze and Cherry, 1979). This implies that most contamination would be introduced from the more permeable sediments above, and then flow almost directly downward in the lower-conductivity sediments.

The quantity and direction of refracted flow is directly proportional to the pressure head difference between the two media of contrasting hydraulic conductivity.

4.3.2 Surface Water Exposure Media

On-site surface water is limited to the runoff from the roof of the production/warehouse building and paved areas. The runoff is discharged to a drainage swale, located at the northeast corner of the site. Here the discharge water ponds and either evaporates or infiltrates into the soil. Surface water runoff is limited as the site is virtually flat non-landscaped and does not possess a coherent drainage pattern.

The nearest surface water body to the site is the Permanente Creek. Permanente Creek is approximately 600 feet to the northwest of the Jasco site and flows north-northwest towards the San Francisco Bay. It is concrete-lined and channelized for drainage control purposes. The sole use of Permanente Creek is for drainage and flood control. Surface water at the Jasco site does not drain into it.

4.3.3 Air and Soils Exposure Media

Contaminated soils are confined to the Jasco site and are not easily accessible to the public. The contaminated zone is not in the normal Jasco working area, therefore is undisturbed. Although there is an obvious lack of surficial soil sampling, analysis of soil samples taken indicate that the high concentrations of chemicals occur in the 3-10 feet depth interval. Soil survey data also indicate that contaminated soils are restricted to the Jasco site and that surface soils in the contaminated zone are somewhat cemented and are not readily available for aeolian transport.

4.4 Potential Exposure Pathways

The Endangerment Assessment for the Jasco site has attempted to be as comprehensive as possible, resulting in the consideration of a variety of potential exposure pathways/scenarios. These scenarios are also descriptive of two distinct time frames: 1) the current site condition, and 2) potential future land-uses of the site property and surrounding areas. The following discussions describe these time frames and the exposure implications of these scenarios based on exposure media.

4.4.1 Current Land-Use

Exposure to indicator contaminants are not expected to occur under the current land-use of the Jasco site. This assumption is based primarily on the fact that Jasco will not be operating at the current location past 1992 and the inaccessibility to the contaminated areas. Exposure pathways associated with current land-use of the Jasco site are discussed below. A summary of the potential exposure pathways based on the following discussions for current site conditions are presented in Table 4-1.

Soils

The potential for exposure to contaminated soils by way of dermal absorption and/or incidental ingestion is assumed to be very low to non-existent. Contaminated soils are limited to the Jasco site in a confined area which is not easily accessible to the public and is not located in a normal work area. The potential receptors for the exposure medium are limited to Jasco employees and trespassers. Dermal absorption is insignificant due to the high volatility of the chemicals of concern. Ingestion of contaminated soils is highly unlikely since on-site activities, such as gardening, are not occurring under the current land-use conditions.

TABLE 4-1

POTENTIAL PATHWAYS OF EXPOSURE TO CONTAMINANTS ORIGINATING AT THE JASCO SITE UNDER
CURRENT LAND-USE CONDITIONS

Exposure Medium	Potential Routes of Exposure	Potential Receptors	Pathway Completely	Potential for Substance Exposure
Soil	Dermal absorption, incidental ingestion.	Workers, trespassers.	No Contaminants are contained within 3-10 feet depth interval.	None
Air	Inhalation of VOCs and/or fugitive dust.	Workers, trespassers. Local population downwind of site.	No Contaminants are contained within 3-10 feet depth interval.	Very Low
Ground Water	Ingestion, inhalation, dermal absorption.	Local population of Mt. View	No, public water supplemented with water from wells outside area of influence. No private wells are in use.	None

Air

Jasco employees and residents, located down wind and adjacent to the Jasco site may potentially be exposed to volatile organics and/or contaminated fugitive dusts. Inhalation exposure from the volatilization of organic chemicals in the soils and contaminated fugitive dust is assumed to be very low. As stated in the previous section, the high concentrations of chemicals occur in the 3-10 feet depth interval and are therefore not exposed to the surface. It is also noted that the surface soils in the contaminated zone are somewhat cemented and are not readily available for aeolian transport. Therefore if the soils are not disturbed the potential for volatilization and aeolian transport is very low. Since the contaminated soils are not located in a normal working area, it is assumed that the contaminated zone would remain undisturbed.

Ground Water

Potential contaminated exposure through ingestion inhalation, and/or dermal absorption of contaminants present in the ground water is non-existent. The reasons for this being the regulation of ground water use by the SCVWD and the results of the potential conduit investigation as discussed in the previous sections. Based on the available information it is unlikely that a significant public health risk would occur under the current land-use conditions.

- o The A-B-aquifers are not used as a drinking water source.
- o There are no water producing wells down gradient of the Jasco site, within the boundary of the potential conduit investigation.
- o Regulation of the ground water use by the SCVWD.

4.4.2 Potential Future Land-Use

Potential future land-use of the Jasco site is dictated by the zoning change to residential, which went into effect in December 1983. Therefore the most likely exposure scenario involves future residential use for the Jasco site. A summary of potential exposure pathways is based on the following discussion for potential future land-use and are summarized in Table 4-2.

TABLE 4-2

POTENTIAL PATHWAYS OF EXPOSURE TO CONTAMINANTS ORIGINATING AT THE JASCO SITE UNDER
POTENTIAL FUTURE LAND-USE CONDITIONS

Exposure Medium	Potential Routes of Exposure	Potential Receptors	Pathway Completely	Potential for Substance Exposure
Soil	Dermal absorption, incidental ingestion.	Construction workers and on-site residents.	Yes, if surface is disturbed	Moderate, periodic and short-term.
Air	Inhalation of VOCs.	Nearby residents Construction workers on-site residents.	Yes, if surface is disturbed.	Very low, high volatility and dispersion.
	Fugitive dust.	Construction workers on-site residents.	Yes If surface is disturbed.	Moderate, periodic and short-term
Ground Water	Ingestion, inhalation, dermal absorption.	Local population	Yes, if private well installed in area of plume.	High

Soils

Potential exposure to contaminants in soils via dermal absorption and incidental ingestion may occur as a result of on-site construction activities during the redevelopment stage of the Jasco property. This may include excavation type activities such as foundation, sewer, or utility line installation. This type of exposure is expected to be short-term with a low potential for repeated exposure.

Adult residents and children may become exposed to contaminants in soils as a result of gardening activities and playing. This would include both dermal absorption and incidental ingestion of contaminated soils. The contribution by dermal absorption is expected to be low due to the high volatility of the organic chemicals involved.

Air

Residents located downwind and adjacent to the Jasco site and construction workers may potentially be exposed to airborne volatile organic and/or contaminated fugitive dust. Potential exposure may occur as a result of on-site construction activities during the redevelopment of the property. On-site residents including children may become exposed to airborne volatile organic and contaminated fugitive dust as a result of gardening activities and playing. Exposure to airborne volatile organics is anticipated to be infrequent and of short duration with concentrations greatly reduced by ambient air during dispersion. Exposure resulting from contaminated fugitive dust generation is also considered to be periodic and of short duration. The potential for exposure is expected to be moderate.

Ground Water

Future land-use of the Jasco site may include the development and use of private supply wells completed within the contaminated A-aquifer. If these wells are utilized by the residents for drinking and showering, exposure to contaminants by way of ingestion of contaminated ground water and inhalation of volatile organic and dermal absorption may be significant.

4.4.3 Conclusions

The following is a summary of the contents of this section.

1. Land-use in this Endangerment Assessment Study Area is predominantly residential, occupying approximately 90% of the land in the study area.
2. The residential population of the area is large and the current trend indicates that population growth is on the incline.
3. A and B,-aquifers, are not used for drinking water purposes in the vicinity of the Jasco site. The City of Mountain View operates several municipal wells in the general area of the site which draw water from the C-aquifer. Agricultural uses are practically non-existent in the City of Mountain View. Sampling data from off-site wells suggest that ground water transport of site contaminants to public wells has not occurred to date. If private supply wells are completed within the A-aquifer and utilized for drinking and showering, exposure may be high.
4. Surface water within the study area has no commercial or residential use and is not considered a potential migration pathway.
5. Contaminated soils are limited to the site. Under current site conditions volatilization of organic chemicals and aeolian transport of contaminated fugitive dust are highly unlikely due to the fact that contaminants are contained within the 3-10 feet depth interval and surface soils are somewhat cemented. If these soils are disturbed during future-use (development and gardening activities) significant exposure to airborne volatile organics is anticipated to be low due to concentrations being greatly reduced by ambient air during dispersion.

4.5 Exposure Point Concentrations

The degree, or magnitude, of exposure to a contaminant is primarily reliant upon the exposure point concentrations. It was determined through past monitoring data that the drainage swale is the on site area which is the most contaminated. For this reason, the drainage swale area was determined to be the primary exposure point from which exposure point concentrations have been determined.

The concentrations in this Endangerment Assessment were determined and expressed in terms of long-term exposure (average concentrations over time) and short-term exposure (high concentrations over

time). Short-term exposure levels are the concentrations to which population may be exposed for short periods of time, usually 10 to 90 days. Long-term exposures are defined as the concentrations to which populations may be exposed over a long period of time, usually 70 years. This range of values was chosen to best illustrate the levels of exposures which can occur. Computerized models were used to estimate ground water contaminant distribution over a 70 year period. There were major uncertainties associated with estimating potential contaminant migration, through computerized models, from the Jasco site. Little hydraulic data was available for areas beyond the site and contaminant degradation and transport processes were not defined in accordance to field conditions.

Additional information on modeling efforts can be found in Appendix C. Summaries of exposure point concentrations are presented in Table 4-3 through Table 4-5.

4.5.1 Exposure Point Concentrations Determination Methodology

The following conventions were used to characterize the concentration levels of indicator contaminants at the exposure points. High values were reported in order to illustrate the range of data and to estimate the high exposure concentrations. In cases where the indicator contaminants were reported as not detected in the sampling reports or where concentrations were reported as less than the upper bound value, the exposure value was conservatively assumed to equal the upper bound value. When estimating values determined through numerical modeling, the data points with concentrations less than established water quality standards or criteria were not used in determining the average concentration. All average concentrations were derived by taking the arithmetic mean (average) of the projected data point concentrations (numerical modeling) or sampling data obtained from sampling reports.

Ground Water

Average values were obtained by taking the average of all projected data point concentrations over a 70 year period determined by numerical modeling. High values were developed by selecting the data points which projected the highest concentration levels over time.

Soils

Average values were obtained by taking the average concentration of samples collected over space and time. High values were determined by adding the value of two standard deviations to the average

TABLE 4-3
EXPOSURE POINT CONCENTRATIONS
(GROUND WATER)

Indicator	Average	High
Contaminant	Concentration(1)	Concentration(2)
	(mg/l)	(mg/l)
1,2-DCA	1.7×10^{-1}	1.6×10^1
1,1-DCE	5.5×10^{-2}	3.3×10^0
TCE	9.6×10^{-1}	1.2×10^2
Vinyl Chloride	3.1×10^{-3}	9.8×10^{-2}
Benzene	1.9×10^{-2}	7.3×10^{-1}
Tetrachloroethylene	5.8×10^{-2}	4.3×10^0
Methylene Chloride	6.8×10^0	8.7×10^2
1,1-DCA	2.0×10^{-1}	1.3×10^1
PCP	8.2×10^{-3}	3.1×10^{-1}

- (1) Arithmetic mean of projected concentration levels over time determined through computerized modeling.
- (2) Arithmetic mean of projected highest concentration points over time determined through computerized modeling.

TABLE 4-4
EXPOSURE POINT CONCENTRATIONS
(SOILS)

Indicator Contaminant	Average Concentration(1) (mg/kg)	High Concentration(2) (mg/kg)
1,2-DCA	1.0×10^{-1}	9.9×10^{-1}
1,1-DCE	2.2×10^{-1}	3.6×10^0
TCE	6.5×10^0	1.2×10^2
Vinyl Chloride	5.0×10^{-2}	5.0×10^{-2}
Benzene	9.8×10^{-2}	8.0×10^{-1}
Tetrachloroethylene	1.8×10^0	1.6×10^1
Methylene Chloride	4.8×10^1	8.0×10^1
1,1-DCA	1.2×10^0	1.5×10^0
PCP	1.0×10^{-1}	3.0×10^{-1}

- (1) Average concentration equals the arithmetic mean of concentrations of samples collected over space and time.
- (2) High concentration equals adding the value of two standard deviations to the arithmetic mean value.

values. These values provide a rough estimate of the upper 95% confidence interval for the average concentration that an individual could be exposed to over a number of exposure events.

Air

Concentrations of contaminants in air, due to volatilization of contaminants detected in ground water, were assumed to be the same as those projected for ground water (Andelman 1985). This assumption is based on 100% volatilization of the contaminant. Therefore, average and high values are the same as those developed for ground water.

4.6 COMPARISON TO OF APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARARs)

The section discusses "Applicable or Relevant and Appropriate Requirements" (ARARs) with respect to the Jasco site Endangerment Assessment. The purpose of this section is to compare actual and projected contaminant levels to ARARs. ARARs for indicator contaminants are used as a comparison to the exposure near and at the site. This comparison will indicate if there is an excessive exposure and potential risk to human health.

In the USEPA's July 1987 Interim Guidance on Compliance with ARARs, EPA defines applicable requirements as "those cleanup standards, standards of control, and other substantive environmental protection requirements, criteria, or limitation promulgated under Federal and State law that specifically addresses a hazardous substance pollutant, contaminant, remedial action location or other circumstance at a CERCLA site (Inside Washington Publishers 1987). EPA also specifies relevant and appropriate requirements as "those cleanup standards, standards of control, or other substantial environmental protection requirements, criteria, or limitations promulgated under Federal and State law that while not 'applicable' to a hazardous substance pollutant, or contaminant, remedial action, location or other circumstance at a CERCLA site, address problems or situations sufficiently similar to those encountered at the CERCLA site and that their use is well suited to the particular site" (Inside Washington Publishers 1987). Potentially applicable requirements include Clean Air Acts National Ambient Air Quality Standards, and the Safe Water Acts Maximum Contaminant Level Goals (MCLGs).

At the Jasco site, exposure could occur through ground water, air and soil media. The following sections discuss ARARs and other criteria for each of these media and compare these standards or limitations against actual or projected contaminant levels for the indicator contaminant.

TABLE 4-5
EXPOSURE POINT CONCENTRATIONS
(AIR)(1)

Indicator Contaminant	Average Concentration(2) (mg/m3)	High Concentration(3) (mg/m3)
1,2-DCA	1.7×10^{-1}	1.6×10^1
1,1-DCE	5.5×10^{-2}	3.3×10^0
TCE	9.6×10^{-1}	1.2×10^2
Vinyl Chloride	3.1×10^{-3}	9.8×10^{-2}
Benzene	1.9×10^{-2}	7.3×10^{-1}
Tetrachloroethylene	5.8×10^{-2}	4.3×10^0
Methylene Chloride	6.8×10^0	8.7×10^2
1,1-DCA	2.0×10^{-1}	1.3×10^1
PCP	8.2×10^{-3}	3.1×10^{-1}

- (1) Vaporization of ground water, assumes 100% vaporization.
- (2) The average concentration equals arithmetic mean of projected concentration levels in ground water over time determined through computerized modeling.
- (3) High concentrations equals arithmetic mean of projected highest concentration points in ground water over time determined through computerized modeling.

4.6.1 ARARs for Ground Water

The ARARs for current use of ground water in the vicinity of the Jasco site are standards and criteria established for drinking. Although there is currently no use of A-aquifer ground water for drinking in the vicinity of the Jasco site, the potential risk that would result if the ground water from this aquifer were ingested was evaluated using the MCLGs permissible in water which is delivered to 25 or more people, or 15 or more service connections. Other criteria that were used to assess the potential risk associated with the consumption of A-aquifer ground water include the proposed MCLs, MCLGs and the California State Action Levels Criteria which are designed to protect human health from chemical constituents in the drinking water. Table 4-6 summarizes the potential ARARs and other criteria established for drinking water.

The USEPA's Drinking water Health Advisories, in addition to MCL's and MCLG, also provide guidance for establishing drinking water quality standards. These advisories exist for 54 chemicals or chemical groups, seven of which are on the Jasco site indicator contaminant list (see Table 4-7). The exposure levels are established to migrate adverse health effects to the public. A safety factor has also been incorporated to protect sensitive population.

The definition for headings used for Table 4-7 follow:

- o One-day: Concentration calculation is based on 10-kg Child (one-year-old infant) consuming one liter of water per day.
- o Ten-day: Concentration calculation is based on a 10-kg child (one-year-old infant) consuming one liter of water per day.
- o Long Term: Concentrations are calculated for both 10-kg child concerning one liter of water per day and 70-kg adult consuming two liters of water per day.
- o Lifetime concentrations are calculated for a 70-kg adult consuming two liters of water per day.
- o Reference Concentrations for Potential Carcinogen. These concentrations indicate a risk of 10^{-6} .

4.6.2 ARARs for Air

The National Ambient Air Quality Standards (NAAQ) are the only regulations applicable to air contaminants at the Jasco site. The State of California provides no State specific ambient air quality criteria. It should be noted, however, that occupational exposure limits provided by the Occupational

TABLE 4-6
POTENTIAL ARARS AND OTHER CRITERIA
FOR CONTAMINANTS IN WATER

Indicator Contaminant	MCL(1) mg/l	MCLG(2) mg/l	CSAL(3) mg/l	Proposed MCL(1) mg/l	Proposed MCLG(2) mg/l
1,2 DCA	(4)	0	.001	.005	---
1,1 DCE	---	.007	.006	.007	---
TCE	---	0	.005	.005	---
Vinyl Chloride	---	0	.002	.001	---
Benzene	---	0	.0007	.005	---
Tetrachloroethylene	---	---	.004	---	0
Methylene Chloride	---	---	.040	---	---
1,1 DCA	---	---	.020	---	---
PCP	---	---	.0022	---	0.22

1. Maximum Contaminant Limits by the Federal Safe Drinking Water Act (USEPA 1986).
2. Maximum Contaminant Level Goal proposed by the USEPA (1986).
3. State Act Level, by the State of California, September 1987.
4. Not available.

TABLE 4-7
EPA DRINKING WATER HEALTH ADVISORS

Indicator Contaminant	One-Day	Ten-Day	Long-Term		Life-Time	Reference Concentration for Potential Carcinogens(2)
	ug/l Infant(3)	ug/l Infant(3)	ug/l Infant(3)	ug/l Adult	ug/l Adult	ug/l Adult
1,2 DCA	740	740	740	2600	N/A	0.95
1,1 DCE	1000	1000	1000	3500	---	0.24
TCE	---	---	---	---	---	2.8
Vinyl Chloride	2600	2600	13	46	N/A	0.015
Benzene	233	233	N/A	N/A	N/A	0.35
Tetrachloroethylene	---	34000	1940	6800	---	0.70
Methylene Chloride	13300	1500	---	---	---	5.0
1,1 DCA	---	---	---	---	---	---
PCP	1000	300	300	1050	220	---

1. Source: USEPA, 1985.

2. Values indicate a risk of 10^{-6}

3. 12 months.

Note: See text explanation for heading.

TABLE 4-8
AIR STANDARDS (NON-ARARS)

Indicator Contaminant	PEL ⁽¹⁾ mg/m ³	TLV-TWA ⁽²⁾ mg/m ³
1,2 DCA	---	40
1,1 DCE	---	20
TCE	270	270
Vinyl Chloride	---	10
Benzene	10	30
Tetrachlorethylene	170	335
Methylene Chloride	---	175
1,1 DCA	400	810
PCP	0.5	0.5

1. From: Occupational Safety and Health Administration, 1989.
2. From: American Conference of Governmental Industrial Hygienist, 1989.

Safety and Health Administration (OSHA) and the American Conferences of Governmental Industrial Hygienists (ACGIH) do exist. These exposure limits are calculated as Permissible Exposure Limits (PEL), as provided by OSHA or as Threshold Limit Value-Time Weighted Average (TLV-TWA) as provided by the ACGIH. Both values are exposure limits assuming an 8-hour work day with a 40-hour work week (see Table 4-8). These values are presented as possible reference levels only and do not imply ARAR status.

4.6.3 ARARs for Soils

There are no Federal standards for contaminant levels in soils. The State of California, Department of Health Services has established Hazardous Waste Threshold Limit concentrations for some organic constituents including TCE and vinyl chloride. The toxicity criteria for these compounds are based on acute fish toxicity. The limits are called Soluble Threshold Limit Concentrations (STLCs) and Total Threshold Limit Concentrations (TTLCs). STLC and TTLC values for TCE and vinyl chloride are shown in Table 4-9. These values are presented as possible reference levels only and do not imply ARAR status.

4.6.4 Results of Comparison

1,1 DCE exceeded or could be predicted to exceed the MCL standard in ground water (see Table 4-10). No potential ARARs were identified for the remaining seven indicator contaminants in ground water, soils or air. However, concentration levels of the seven indicator contaminants did exceed other criteria established by the State of California and the proposed MCL limits set by the USEPA.

TABLE 4-9
SOIL STANDARDS (NON-ARARS)¹

Contaminant	Soluble Threshold Limit Concentrations (mg/l)	Total Threshold Limit Concentration (mg/kg)
TCE	204	2040
Vinyl Chloride	NA ²	10

1. State of California, Department of Health Services, 1987.
2. Not available.

TABLE 4-10
EXPOSURE POINT CONCENTRATIONS VS POTENTIAL ARARS
OR OTHER CRITERIA FOR CONTAMINANTS IN GROUND WATER

Indicator Contaminant	Potential ARARs (mg/l)	Other Critical(1) (mg/l)	Contaminant Concentration(2) (mg/l)	Standard Ratio
1,2 DCA	---	.001	0.17	170
1,1 DCE	.007	---	0.055	8
TCE	---	.005	0.96	192
Vinyl Chloride	---	.001	0.0031	3
Benzene	---	.0007	0.019	27
Tetrachloroethylene	---	.004	0.058	15
Methylene Chloride	---	.04	6.8	170
1,1 DCA	---	.02	0.2	10
PCP	---	.0022	0.0082	3.73

(1) Potential ARARs and other criteria listed in Table 4-6.
(2) Average concentrations.

SECTION 5.0

HUMAN INTAKE ASSESSMENT

5.1 Introduction

Since all indicator contaminant concentrations in ground water exceeded ARAR standards or other criteria limits, the risk characterization process was conducted for each exposure scenario. The concentration for the indicator contaminants at exposure points are used to calculate the exposure and intake levels for future land-use scenarios. The assessment of human intake is quantified in this section for those exposure events that were thought to be the most possible. These include the exposures that are likely to occur on a much more regular basis. The risk estimates for these most probable events were developed using a mathematical matrix that made provisions for a distribution of exposure and subsequent intake as a function of, for example, time activity and body weight.

This section describes the procedures used to determine human intake resulting from ingestion and inhalation exposure. Risks resulting from dermal intake are not calculated in this Endangerment Assessment because no methodologies are currently unavailable for inclusion with the intake estimates currently used.

The intake scenarios used in this section are representative of exposures assumed would occur on a repeating and regular basis. These include for example direct consumption of ground water at or in proximity of the Jasco site.

5.2 Intake Calculation Assumptions

Estimating human intake exposure point concentrations required the development of a methodology that represents the variability of exposure. For each separate scenario specific assumptions applicable only to them were developed. However, in many cases standard assumptions common to all exposures and consequently intakes were used. In particular, the standard weights of 70 kilograms (154 pounds) for adults and 17 kilograms (38 pounds) for children were used. These standard assumptions were applied for exposure to both ground water and soils. Although there are currently several reviews taking place by the USEPA and the scientific community on the issue of actual values for body weight, the values stated above were used in view of the traditional consensus presented in USEPA methodology (USEPA 1986).

Similarly although a range of values exist for total daily water consumption by adults and children, the traditional approach under SPHEM and Superfund Exposure Assessment Manual (SEAM) guidance documents is to use two liters (.53 gallons) per day for adults and one liter (.27 gallons) per day for children. Although these values are conservative as direct consumption values, and lower values are more reasonable, a narrow range around these values was assumed to be more suitable for conditions present at the Jasco site.

The definition of short-term (subchronic exposure) and long-term (chronic exposure), as they pertain to discussion in this document are 10 to 90 days and 70 years, respectively. Those assumptions are documented in SPHEM (USEPA 1986). For the purpose of this Endangerment Assessment the 90 day duration was selected as the short-term duration. Given the exposure scenarios selected, this time period was considered likely to provide a more accurate estimate of exposure to the identified indicator contaminants at the characterized exposure points discussed in Section 4.0. It should also be noted that intakes for children were only calculated for the short-term period, and not for the lifetime 70 year period, as the duration of childhood is limited.

The emphasis of the methodology presented below was to take into consideration as much of the potentially explored population as possible and identify those intakes that could potentially result in clinical manifestations of toxicological end points. In order to do so assumptions were chosen to be conservative enough to include the 90th percentile of the population within the Jasco study area, as it would be unreasonable to predict that all of the population would fit the assumptions all of the time. The following sections predict the intake calculation assumptions specific to the exposure media, with scenario specific discussion.

5.2.1 Water Ingestion

The ingestion of water at the hypothetical residences using private wells completed within the contaminated A-aquifer is described in this section. The assumptions used in calculating ground water ingestion, as the sole source of drinking water, would average two liters per day as a consumption rate, for adults, and one liter per day for children (USEPA 1986). In addition, it was assumed that as both a best estimate and a maximum plausible value, 100 percent of the water consumption by children occurs at home. Adults were assumed to consume 80 percent of their water at home as a best estimate, and 100 percent as a maximum plausible value. These assumption were made because adults are likely to consume water both at home and away from home. Children were conservatively assumed to consume 100 percent of their water at home.

Since the source of ground water for this scenario is residential, it was reasonable to assume that every day of a short-term, 90-day period and a long-term 70 year (25,550 days) period, represented a day of ground water ingestion for adults.

5.2.2 Soil Ingestion

This section describes the assumptions that were used to calculate soil ingestion for the future land-use scenarios in which outdoor activities involve adult construction workers, adult residents engaged in yard work activities and children playing in areas where contaminated soils can be contacted.

There are many studies reporting a wide variety of soil ingestion rates. In general the range values are from 25 to 100 mg per day, as best estimate, up to 100 to 500 mg per day (LaGoy 1987). These values are highly dependent on age and activity. For this Endangerment Assessment values within these ranges were used to represent a reasonable approach.

The USEPA (1988) report average soil ingestion values for 3.5 to 5 year old children as 0.05 grams (50 mg) per day and 0.2 grams (200 mg) per day for 1.5 to 3.5 year old children. These values were used as best estimate and maximum plausible values, respectively, for soil ingestion. The value of 0.5 grams (500 mg) of soil ingested per day for adults was used as a maximum plausible value, this was based on an estimate of outdoor activity involving yard work at eight hours per day (Hawley 1985). A value of 0.2 grams (200 mg) per day was used as the best estimate.

The time of exposure varies with the individual scenarios. Studies by Hill (1985) have shown that outdoor work can range between approximately 15 to 26 hours per week for men and women,

therefore the resident that works the soil can be expected to work at least two days per week as a best estimate, and up to four days per week as a maximum plausible. These values were used in calculating time of exposure for soils to resident adults. It was assumed that children were exposed to soils for an equal number of days of outdoor activities. Short-term and long-term exposures for adults were assumed to be 90 days and 70 years, respectively.

During the redevelopment scenario, the potentially exposed persons are assumed to be construction workers who may encounter contaminated soils during redevelopment of the Jasco site and incidentally ingest 200mg (best estimate) to 500 mg (maximum plausible) of soil. Exposure time was conservatively assumed to be eight hours per day, five days per week for both best estimate and maximum plausible over a 90 day period of time. Longer exposures are not anticipated as excavation type activities for construction purposes are not prolonged.

5.2.3 Particulate Inhalation

The inhalation of airborne particulates was assumed to be limited to the future land-use scenarios where construction work is taking place, and/or tending and playing in a residential garden occurs. Air particulate concentrations were estimated based upon monitoring data collected at two residential construction sites in Arizona and Nevada (USEPA 1974). Although not site specific, this estimated value of 0.29 mg/m^3 was considered a conservative estimate of the air particulate concentrations that an individual may encounter at the Jasco site. Of this 0.29 mg/m^3 of particulate concentration, it was considered that 50 percent was respirable [particulate matter the size of 0.5 and 5.0 microns (Wedgman and Levy 1979)] as a best estimate, and 60 percent was respirable for a maximum plausible condition.

The inhalation rates of adults and children vary, depending on the level of activity. A moderate level of activity was assumed for construction workers and adults performing gardening activities. Therefore, adults were assumed to inhale at a rate of 2.6 m^3 per hour as best estimate for the average adult (USEPA 1988), and 2.8 m^3 per hour as a maximum plausible. This value was calculated by the USEPA (1988) for an adult male. Children were assumed to undergo heavy activity while playing outdoors and were assumed to inhale at a rate of 2.4 m^3 per hour as best estimate, and 4.2 m^3 per hour as maximum plausible value (USEPA 1988).

The best estimate exposure duration for adults was assumed to be eight hours per day, two days per week. Maximum plausible exposures for adults were assumed to be eight hours per day for four days per week. Children were assumed to be outdoors for 1.5 hours per week (best estimate) and 2.0 hours per week (maximum plausible) (Timmer et. al. 1985). Inhalation of particulates was assumed to occur

only half of the time over the 70 year period representing long-term exposure. This assumption accounts for periods of inactivity due to inclement weather, illness, and any other reason that would preclude outdoor activities. As a conservative estimate it was assumed that short-term exposure to particulate contaminants occurs at every occurrence of outdoor activity. This assumption could be considered reasonable as the short-term 90 day exposure duration can represent the summer months when outdoor activities are frequent.

Both best estimate and maximum plausible exposure durations for construction workers were assumed to be eight hours per day, five days per week. Exposure is expected to be of only short-term duration (90 days), as construction activities are not for extended periods of time.

5.2.4 Inhalation of Vapors While Showering

This section describes the assumptions used to calculate inhalation of volatilized contaminants while showering. This is applicable to the future land-use scenario in which ground water is the source of residential potable water. For the purpose of this Endangerment Assessment showering activities were limited to adults.

As stated in Section 5.2.3 inhalation rates are dependent upon the level of activity of an individual. A light level of activity resulting in an inhalation rate of 1.3 m^3 per hour (USEPA 1988) was assumed for adults while showering. This rate was considered as both a best estimate and maximum plausible value since it was assumed that a light activity level is representative of showering for the entire exposed population.

Studies by Hill (1985) have shown that showering activities can range from 0.5 hours per week (five minutes per day), to 1.2 hours per week (10 minutes per day). These values were used for both best estimate and maximum plausible exposure durations. It was also assumed that showering occurs every day for both short-term and long-term periods.

As a conservative estimate it was calculated that 100 percent of the ground water contaminants are available for inhalation intake during the showering scenario.

5.2.5 Dermal Exposure to Soils

Dermal exposure was assumed to occur in the same intake scenarios as discussed in soil ingestion and particulate inhalation sections. Intakes and subsequent risks resulting from dermal intake were not

calculated in this Endangerment Assessment, due to the lack of acceptable methodology for the determination of risks due to dermal exposures.

5.2.6 Dermal Exposure to Water

The dermal exposure to ground water was assumed to occur in the future land-use scenario when ground water is used for showering. Dermal intakes were not calculated for those reasons stated previously in Section 5.2.5.

5.2.7 Inhalation of Vapors, Outside of Residence

Inhalation of contaminants from the volatilization of volatile organic compounds in the soils was assumed to occur in the future land-use scenario in which outdoor activities involve the construction workers, adults, and children.

A highly conservative screening analysis was conducted to determine the potential health risk associated with inhalation exposure from the volatilization of the indicator contaminants in the soils. This analysis is presented in Appendix D and shows that the exposure to air emissions resulting from the volatilization of contaminants of the soils would not pose a significant health risk to the surrounding residents and worker population. The total upper-bound incremental lifetime risk at the point of maximum concentration was calculated to be 5.8×10^{-7} which is at the upper-bound limit of the carcinogenic risk range established by USEPA.

5.3 Intake Analysis

The calculation of intake (mg/kg/day) was completed for both subchronic (90 days) and chronic (70 years) scenarios. The receptor-specific intake rates are presented in Tables D-1 through D-9 in Appendix D. Each table presents the intake rate of a specific contaminant via a specific medium for adult residents, construction workers or children. The calculation of both best estimate and maximum plausible intake rates was completed using the set of parameters described in the preceeding sections. Comparison of these calculations show that the largest oral and inhalation intake value for contaminants is via ground water ingestion by adults and children.

SECTION 6.0

RISK CHARACTERIZATION

6.1 Introduction

This section describes the potential health risks associated with the exposure scenarios developed during the exposure assessment. To characterize the potential risks associated with the Jasco site, the exposure scenarios are integrated with the results of the toxicity assessment.

The potential risks associated with the indicator contaminants were quantified by using the short-term (subchronic) and long-term (chronic) daily contaminant intake. Intake amounts were then compared to published acceptable chronic and subchronic daily intake levels to assess potential non-carcinogenic health effects. Potential lifetime cancer risks were derived by using published carcinogenic potency factors.

In some cases the indicator contaminants exert carcinogenic effects that are of greater concern than the non-carcinogenic effects, or the carcinogenic effects are so severe that research has not substantially differentiated between the two effects when this is the case (e.g. 1,2-Dichloroethane, Benzene, Trichloroethane, and Vinyl Chloride) the Endangerment Assessment addressed the more significant carcinogenic effect. In other cases where research has been able to substantially characterize non-carcinogenic effects and carcinogenic effects for indicator contaminants (e.g. 1,1-Dichloroethene, Methylene Chloride, and Tetrachloroethylene) both non-carcinogenic and carcinogenic risks were calculated. By this rationale, the Endangerment Assessment characterizes non-carcinogenic and carcinogenic risks to the furthest and most practical level available based on the known scientific evidence as presented in the toxicological profiles.

6.2 Non-Carcinogenic Risk Assessment Methodology

For non-carcinogens, the U.S. EPA has calculated acceptable daily intakes for both short and long term. Since short-term (sub-chronic) exposure to relatively high concentrations of chemical contaminants can cause different toxic effects than those caused by long-term (chronic) exposure to lower concentrations, two intake levels are calculated for each chemical, the sub-chronic acceptable intake (AIS) and the chronic acceptable intake (AIC). The acceptable daily intakes are specific to exposure routes, oral and inhalation, and are expressed in mg/kg/day. Acceptable daily intake levels for indicator contaminants used in this assessment were determined by using the USEPA Integrated

Risk Information System (IRIS) (USEPA 1989), and through the aid of Region IX EPA (USEPA 1989a). A summary of oral and inhalation AISs and AICs are listed in Table 6-1.

Once the acceptable reference intake was determined, the hazard indices (HI) were determined by dividing the appropriate calculated intake levels by the appropriate acceptable intake reference level. This comparison results in a ratio of estimated intake:acceptable intake. Any chemical with an intake level greater than the acceptable intake levels will cause the HI to exceed unity. When an HI exceeds unity there may be a concern for potential health risks (USEPA 1986). These health risks are discussed in the detailed chemical-specific Toxicological Profiles presented in appendix B. Total hazard indices are based upon the comprehensive levels that may be incurred by an individual. Total hazard indices are calculated by adding the chemical-specific hazard indices together.

6.3 Carcinogenic Risk Assessment Methodology

Carcinogenic Risks were calculated for indicator contaminants that have been identified as being potential human carcinogens. This identification process has been performed by the USEPA and is based on current toxicological/epidemiological evidence.

Carcinogenic risk calculations were performed by using individual long-term intake levels of indicator contaminants for both best estimate and maximum plausible, and multiplying them by the appropriate chemical-specific carcinogenic potency factor (CPFs) presented in Table 6-2. The CPF anticipates the probability of occurrence of a lethal cancer within a lifetime and is expressed in units of $(\text{mg}/\text{kg}_{\text{bodyweight}}/\text{day})^{-1}$. This factor is an upper 95 percent confidence limit on probability of response per unit intake of a chemical over a lifetime. Therefore there is only a five percent chance that the probability of a response could be greater than the estimated value on the basis of experimental data used. If the exposure assessment is conservative, the predicted risk is an upper bound estimate. Consequently, the predicted risk may overestimate the actual risk at a site. However, this method is used so that the carcinogenic risk will be underestimated (USEPA 1986).

The resulting product of the CPF x intake is a numerical expression that estimates the excess cancer mortality rate to a population due to intake of a carcinogenic contaminant over a 70 year period. For example, the expression 1×10^{-6} illustrates a potential excess cancer rate to a population to be one in a million attributed to the chemical in question over a 70 year period. The USEPA recognizes an allowable range of carcinogenic risk of 10^{-4} to 10^{-7} after remediation (USEPA 1986).

TABLE 6-1
ACCEPTABLE DAILY INTAKE FOR
INDICATOR CONTAMINANTS
(NON-CARCINOGENIC EFFECTS)

Indicator Contaminant	<u>Oral</u>		<u>Inhalation</u>	
	AIS(1) mg/kg/day	AIC(2) mg/kg/day	AIS(1) mg/kg/day	AIC(2) mg/kg/day
1,2 DCA	---	---	---	---
1,1 DCE	9.00×10^{-3}	9.00×10^{-3}	---	---
TCE	---	---	---	---
Vinyl Chloride	---	---	---	---
Benzene	---	---	---	---
Tetrachloroethylene	1.0×10^{-2}	1.0×10^{-2}	---	---
Methylene Chloride	6.0×10^{-2}	6.0×10^{-2}	9.0×10^{-1}	9.0×10^{-1}
1,1 DCA	1.0	1.0×10^{-1}	1.0	1.0×10^{-1}
PCP	3.0×10^{-2}	3.0×10^{-2}	---	---

- (1) Acceptable subchronic daily intake.
(2) Acceptable chronic daily intake.

TABLE 6-2
CARCINOGENIC POTENCY FACTORS FOR
INDICATOR CONTAMINANTS
(CARCINOGENS)

Indicator Contaminant	Oral Potency Factor mg/kg/day ⁻¹	Inhalation Potency Factor mg/kg/day ⁻¹	Source
1,2 DCA	9.1×10^{-2}	9.10×10^{-2}	USEPA 1989
1,1 DCE	6.0×10^{-1}	1.20	USEPA 1989
TCE	1.1×10^{-2}	1.30×10^{-2}	USEPA 1989a
Vinyl Chloride	2.30	2.95×10^{-1}	USEPA 1989a
Benzene	2.9×10^{-2}	2.90×10^{-2}	USEPA 1989
Tetrachloroethylene	5.1×10^{-2}	3.30×10^{-3}	USEPA 1989a
Methylene Chloride	7.5×10^{-3}	1.40×10^{-2}	USEPA 1989
1,1 DCA	9.1×10^{-2}	---	USEPA 1989a
PCP	1.6×10^{-2}	---	USEPA 1989a

6.4 Risk Analysis

This section evaluates the risk to human health that is posed by the Jasco site. Scientific judgement was used to select best estimate values that probably represent actual intakes at and near the Jasco site and maximum plausible intakes that are based on intake estimates that may occur, but are not necessarily representative of conditions associated with the site. As previously stated complete exposure pathways under current land-use conditions do not exist. Therefore health risks associated with current land-use scenario were not calculated. Potential health risks associated with the projected future land-use scenario (residential occupancy) were calculated and are discussed in the following sections.

6.4.1 Ground Water

The possibility that a small domestic well would be drilled into the A-aquifer for a water supply is very small. The ground water is regulated by the Santa Clara Valley Water District with a fee for ground water withdrawal and neither the A or B-aquifer are currently used for domestic purposes in the vicinity of the Jasco site. A summary of results shown on Table E-1 demonstrates that the chronic hazard indices associated with ground water ingestion by adult residents exceeds unity ($HI_{\text{Best Estimate}} = 3.2$ and $HI_{\text{Maximum Plausible}} = 3.7$). Further analysis of the chemical specific hazard indices reveals that methylene chloride ($HI_{\text{Best Estimate}} = 3.0$ and $HI_{\text{Maximum Plausible}} = 3.3$) is the main contaminant responsible for the high hazard indice calculated for ground water ingestion by adult residents. Subchronic hazard indices for ground water ingestion by adults (see Table E-2) and children (see Table E-3) are less than one and no adverse effects would be expected to occur.

Chronic and subchronic hazard indices associated with inhalation of vapors while showering by adults are presented in Tables E-4 and E-5. Calculations indicate chronic hazard indices are less than one for both best estimate and maximum plausible values. Subchronic hazard indices were found to be 1.2 (best estimate) and 3.0 (maximum plausible). These excessive hazard indices are due to estimated methylene chloride intakes.

Potential excess cancer risks associated with consuming ground water containing carcinogenic indicator contaminants are shown on Table E-6. Calculations indicate a range from 3.4×10^{-6} for pentachlorophenol (PCP) to 1.4×10^{-3} for methylene chloride as best estimate, and 3.8×10^{-6} for

PCP and 1.5×10^{-3} for methylene chloride for maximum plausible values. Cumulative carcinogenic risks associated with ground water ingestion are 3.6×10^{-3} for Best Estimate and 4.0×10^{-3} Maximum Plausible values. Calculation of lifetime cancer risks associated with inhalation of vapor by adults while showering are presented in Table E-7 and show potential excess cancer risk of 2.7×10^{-4} for best estimate and 5.9×10^{-4} maximum plausible values. Methylene chloride presents the highest potential cancer risk for both best estimate and maximum plausible values with potential risks of 1.0×10^{-4} and 2.9×10^{-4} respectively.

6.4.2 Soils

Potential exposure to contaminated soils via incidental ingestion and fugitive dust inhalation by construction workers may occur as a result of on-site construction activities during redevelopment of the Jasco property. On-site residents including children may also become exposed to contaminated soils during gardening activities and playing. The likelihood of the above scenarios being carried out is highly probable since the area surrounding the site is residential and the site property was rezoned residential in 1983 and Jasco is required to vacate the premises by 1992.

Chronic and subchronic hazard indices for contaminated soil ingestion by on-site adult residents are presented in Tables E-8, and E-9. Subchronic hazard indices for children and construction workers are shown in Table E-10 and E-11, respectively. Calculations demonstrate that cumulative hazard indices for all receptors are much less than unity and therefore toxic effects are assumed to be negligible. Cumulative potential excess cancer risks presented by ingestion of contaminated soils by adults are shown on Table E-12 and indicate potential excess cancer risks of 7.3×10^{-7} and 3.7×10^{-6} for best estimate and maximum plausible values, respectively.

Hazard indices for chronic and subchronic fugitive dust inhalation by on-site residents are presented in Tables E-13 and E-14. Subchronic hazard indices associated with fugitive inhalation by children and construction workers are shown in Table E-15 and E-16, respectively. Results indicate that all hazard indices values are substantially less than unity for all receptors and therefore potential non-carcinogenic health risks associated with exposure to contaminated fugitive dust. Therefore no adverse health effect would be expected. Cumulative potential cancer risks associated with inhalation of contaminated fugitive dust by adults are presented in Table E-17 and show potential cancer risk of 6.5×10^{-9} for best estimate and 1.7×10^{-8} for maximum plausible values.

6.4.3 Conclusion

Chronic and subchronic hazard indices were calculated for total daily ingestion of indicator contaminants via ingestion of ground water combined with incidental ingestion of contaminated soils by adults (see Table E-18). Chronic hazard indices for total daily ingestion exceed unity with 3.4 for best estimate and 3.7 for maximum plausible values. Comparison to hazard indices calculated for ground water ingestion (Table E-1) and soil ingestion, (Table E-8) shows that ground water ingestion in particular the ingestion of the contaminant methylene chloride, poses the adverse health effects associated with chronic ingestion of indicator contaminants. Subchronic hazard indices for total daily ingestion of indicator contaminants are less than one for both best estimate and maximum plausible values. Therefore no adverse health effects would be expected.

Chronic and subchronic hazard indices for total daily inhalation of indicator contaminants by way of inhalation of vapors while showering combined with inhalation of contaminated fugitive dust by adults are shown on Table E-19. Calculations indicate hazard indices of less than one for both chronic and subchronic intake values and therefore adverse health effects would be assumed to be negligible.

Table E-20 presents a summary of subchronic hazard indices calculated for total daily ingestion (ingestion of both ground water and contaminated soils) and total daily inhalation (inhalation of contaminated fugitive dust) of indicator contaminants by children. Results indicate that through ingestion hazard indices are substantially greater than one for both best estimate and maximum plausible values. These excessive hazard indices result from the consumption of contaminated ground water by a 17 kg child. Contaminant specific analysis indicates that the intake of methylene chloride under the best estimate assumptions is 6.7. All other best estimate hazard indices are below unity. For the maximum plausible intake assumptions, 1,1-DCE, tetrachloroethylene, and methylene chloride, all have hazard indices substantially excessive of unity (21, 25, and 850 respectively).

Subchronic hazard indices for total daily ingestion (ingestion of contaminated soils) and total daily inhalation (inhalation of fugitive dust) by construction workers are summarized in Table E-21. Calculations indicate hazard indices of considerably less than one for both exposure pathways. Therefore no adverse health effects would be expected from exposure to either pathway.

Table E-22 includes a summary of the potential lifetime cancer risks associated with total daily ingestion. Total daily ingestion includes ground water ingestion combined with soil ingestion. Results show potential lifetime cancer risks of 3.7×10^{-3} for best estimate and 4.1×10^{-3} for maximum plausible values. When potential lifetime cancer risks for total daily ingestion are compared to

potential cancer risks calculated for ground water ingestion (Table E-16) and soil ingestion (Table E-12) it is evident that ingestion of ground water poses the greatest potential lifetime cancer risks.

Potential lifetime cancer risks associated with total daily inhalation of indicator contaminants are also included on Table E-22. Total daily inhalation includes inhalation of vapors while showering combined with inhalation of fugitive dust. Calculations indicate potential lifetime cancer risks of 2.5×10^{-4} for best estimate 6.4×10^{-4} for maximum plausible values. Comparison between the calculated potential lifetime cancer risks associated with total daily inhalation of indicator contaminants to individual potential cancer risks calculated for inhalation of vapors (Table E-7) and inhalation of fugitive dust (Table E-17) shows that the potential cancer risk associated with inhalation of fugitive dust is minimal as compared to inhalation of vapors while showering.

SECTION 7.0 CONCLUSIONS

This section presents the conclusions of the Endangerment Assessment which are listed below. It was determined that the only complete exposure pathway associated with current land-use of the Jasco site was employee and trespasser exposure via inhalation of volatilized contaminants originating in the soils. A screening analysis, using a worse-case scenario indicates a potential carcinogenic risk of 5.8×10^{-7} which is within the USEPA allowable carcinogenic risk range of 10^{-4} to 10^{-7} after remediation.

Separate estimates of the potential for carcinogenic risk and non-carcinogenic risk were calculated for each exposure scenario associated with potential future land-use (residential occupancy) of the site. Risk calculations were made for representative concentrations (best estimate) of the contaminants and for the highest measured contaminant concentrations (maximum plausible). As a result each scenario is associated with four risk calculations: best estimate - carcinogenic; maximum plausible - carcinogenic; best estimate - non-carcinogenic; maximum plausible - non-carcinogenic. The findings were as follows.

- 1) Significant carcinogenic risks were calculated for both best estimate and maximum plausible values associated with ground water (A-aquifer) consumption and inhalation of ground water vapors.
- 2) Significant non-carcinogenic risks were calculated for ground water ingestion using best estimate and maximum plausible contaminant concentration levels.
- 3) There is no significant carcinogenic risk or non-carcinogenic risk associated with exposure to on-site contaminated soils via incidental ingestion or fugitive dust inhalation.

The risk characterization step focused upon human health effects and risks due to the chemical properties of each of the indicator contaminants considered. The results of the risk characterization process were expressed in hazard indices for non-carcinogenic effects and risk levels for carcinogenic effects. For this assessment a hazard index exceeding unity and a risk level exceeding 1×10^{-6} was considered to pose a potential health threat.

Best estimate and maximum plausible hazard indices indicate that chronic and subchronic health effects are not expected as a result to exposure to media containing indicator contaminants for inhalation and ingestion pathways except for chronic daily ingestion of ground water.

The carcinogenic risks were estimated by considering those contaminants for which carcinogenic potency factors have been developed. Under these conditions, best estimate carcinogenic risks of greater than 1×10^{-6} were calculated for ground water ingestion (3.6×10^{-3}) and ground water vapor inhalation (2.7×10^{-4}) scenarios.

For ground water ingestion and inhalation pathways it is important to point out that the non-carcinogenic risk and carcinogenic risk are largely dependent upon the concentration of methylene chloride in the water.

The uncertainties associated with the risks at the Jasco site relate to the procedures and inputs used in the assessment. Uncertainties can result from the use of conservative assumptions which is often the case in exposure assessments where data is lacking. Assumptions made in the process of developing the Endangerment Assessment are noted within the report and have resulted in areas of uncertainty. The identified uncertainties are as follows.

- 1) The results generated by the ground water modeling are based on limited field data without adequate field data describing the subsurface system models cannot predict exposure point concentrations with complete accuracy. In light of these difficulties assumptions were made to evaluate contaminant migration and exposure point concentrations. The application of these assumptions resulted in conservative estimates of exposure point concentrations and subsequent risk estimates.
- 2) The use of the highest recorded contaminant data as exposure point concentrations is another area of uncertainty. It is unlikely that high value data realistically represents the concentration that will be encountered by the public.
- 3) The potential difference between detection limit values used in the assessment and the actual contaminant data is another source of uncertainty that effects the conclusion that a significant risk exist.
- 4) Additional conservativeness is associated with the derivation of critical toxicity values from a limited number of study results (i.e. data extrapolated from animal studies to predict potential health effects of a chemical in human).

SECTION 8.0
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APPENDIX C

RECOMMENDED SITE SPECIFIC
REMEDIATION LEVELS FOR SOIL

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RECOMMENDED SITE-SPECIFIC
REMEDATION LEVELS FOR SOILS
at the JASCO CHEMICAL CORPORATION SITE
IN MOUNTAIN VIEW, CALIFORNIA

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Project #7403

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1.0 INTRODUCTION

This report provides justification for site-specific cleanup levels for chemicals in soils at the Jasco facility in Mountain View, California. These cleanup levels were developed based on the Endangerment Assessment prepared for the site by Jacobs Engineering Inc (Jacobs 1989). The Endangerment Assessment (EA) addresses the potential threat to human health (Human Health Evaluation) and the environment (Environmental Assessment) posed by contamination present at the site.

The Jasco Chemical Corp. (Jasco) Site in Mountain View, CA is on EPA's National Priority List (NPL; Superfund Site List) of hazardous waste sites. Jacobs prepared the EA for the Jasco Site under a Technical Enforcement Support (TES) contract with EPA. The EA was prepared in August 1989, prior to release of EPA's Risk Assessment Guidance on Human Health Assessment (EPA 1989; Interim Final) and was prepared using the older Superfund Public Health Evaluation Manual (EPA 1986).

EPA is currently in the process of developing guidance on the preparation of site-specific cleanup levels. Several internal drafts have been prepared but EPA has not released an external draft. In general terms, it appears that the draft guidance will involve back-calculating cleanup levels based on a site-specific risk assessment.

The cleanup levels developed by OHM for the Jasco site were developed based on the site-specific risk assessment (EA) prepared for the site. OHM followed standard risk assessment procedures as outlined in the EPA (1989a) Risk Assessment Guidance for Superfund: Human Health Evaluation Manual, Part A (Interim Final). Other supporting documents used for guidance included the EPA (1988) Superfund Exposure Assessment Manual, the EPA (1989b) Exposure Factors Manual, and the California Leaking Underground Fuel Tank

(LUFT) Manual (CRWQCB 1989).

Section 2 of the report contains background information on the site and describes the nature and extent of contamination. The next section presents information on the environmental behavior and toxicity of key chemicals. As part of the toxicological assessment, health-based criteria are identified. Section 4 contains a discussion of exposure pathways, the calculation of cleanup levels, and a consideration of background concentrations and cleanup levels that have been used at other facilities. The final cleanup levels and the conclusions of the assessment are presented in Section 5.

2.0 SITE CHARACTERIZATION

This section of the risk assessment contains a brief description of the location, topography, meteorology, and climate of the site. A summary of the nature and extent of contamination is also included. More detailed information on the nature and extent of contamination are provided in the Remedial Investigation and the Feasibility Study.

2.1 Site Background

Jasco Chemical Company operates a bulk chemical repackaging and blending facility at 1710 Villa Street in Mountain View, California (Figure 1). This facility has been in operation since December 1976. Prior to use of the property by Jasco, the site was operated by West Coast Doors, Inc., for manufacturing and painting of commercial and residential doors. The site was rezoned from industrial to residential in December 1983 and Jasco will have to vacate the premises sometime in the near future.

Extensive investigations have been conducted at the site over the past 6 years. These activities are documented in the draft Remedial Investigation report (OHM 1990). These investigations showed the presence of petroleum hydrocarbon products including paint thinner, diesel fuel, and kerosene, and volatile organic compounds including: acetone, 1,2-dichloroethane, 1,1-dichloroethylene, methylene chloride, 1,1,1-trichloroethane, trichloroethylene, tetrachloroethylene, benzene, toluene, and xylene. Pentachlorophenol was also detected in a soil sample from the site.

Jasco has initiated several interim remedial measures at the site. In October and November 1988, Jasco removed over 550 cubic yards of soil from the northern side of the facility at the eastern side of the drainage swale and refilled the excavation with lean concrete. The excavation extended to a depth of 22 to 28 feet based upon the

results of on-site OVA analyses and the depth of the water table (approx 28-30 feet). Confirmation samples were collected at the bottom of the excavation and showed levels of chemicals that were up to four orders of magnitude less than pre-excavation sample results. A more detailed discussion of the excavation program can be found in "Interim Remedial Measures, October through November, 1988," prepared by Harding Lawson Associates.

Jasco is also operating a groundwater extraction system at the north side of the main plant building. This groundwater extraction system is installed in well V-4 and has been pumping at a low flow rate (to limit drawdown) since April 1987. Water samples for laboratory analyses are collected monthly to ensure that concentrations of constituents do not exceed target limits established by the city of Mountain View.

In June of 1988, the site was proposed for the EPA Superfund Amendments and Reauthorization Act (SARA) National Priority List (NPL; Superfund); it was subsequently placed on the NPL. As part of an investigation at an NPL site, an Endangerment Assessment (EA) must be prepared to evaluate whether or not the site poses an imminent and substantial endangerment to public health, welfare, or the environment. This EA can also be used as the basis for establishing remediation goals. An Endangerment Assessment for the Jasco site was prepared by Jacobs Engineering Group, Inc. (Jacobs 1989). The Jacobs EA was used as the basis for this cleanup level determination report.

2.2 Demographics

The City of Mountain View has a population of 58,655 and is located within the San Jose metropolitan area which has a population of approximately 1.3 million. The site is surrounded to the south, west and east by multi-unit residential property. To the north the site abuts property owned and operated by Southern Pacific Railroad (SP). This property is used for commuter and freight rail

transport. To the north of the SP property lies the Central Expressway and additional residential property.

2.3 Environmental Characterization

The site slopes gently to the north towards San Francisco Bay from an elevation of about 64 feet above mean low water (MLW) at the southern property boundary to about 58 feet MLW just north of the Central Expressway. The loading area and parking areas, the driveways and all buildings are surfaced with concrete or pavement and the majority of the site is fenced. The area of the drainage swale is not adequately fenced.

The climate of the Mountain View area is characterized by mild, wet winters and warm, dry summers. Data on precipitation in the area was collected between 1974 and 1982 at the Mountain View Corporation Yard which is located about 1.6 miles east of the JASCO facility. Average monthly rainfall at the Mountain View site ranges from a low of 2.2 mm (0.09 inches) in June to a high of about 76.8 mm (3.0 inches) in January. Nearly 75 percent of the precipitation falls between the months of December and March. The average seasonal rainfall is 320.4 mm (12.7 inches). Evaporation data collected monthly by the California Department of Water Resources indicates that the average seasonal evaporation rate is approximately 119 mm (4.7 inches) per year.

Hydrology

Surface water runoff in the vicinity of the Jasco site is directed to storm sewer lines which discharge to Permanente Creek. Permanente Creek, located 600 feet to the west of the site, is the nearest surface water body to the Jasco facility. In the vicinity of the site Permanente Creek is a concrete lined drainage approximately ten feet deep. No other surface water bodies are located within one mile of the Jasco facility.

Geology

The geology of the site consists of medium and fine-grained alluvium. This material is characteristic of a mid to distal alluvial fan depositional environment and is composed of poorly to moderately sorted, irregularly to well-bedded, low to moderately permeable deposits of clay, silt and clayey silt with occasional beds and lenses of fine to coarse sand. These deposits are Holocene in age (0 to 5,000 years old) and are generally less than 21 feet thick.

On the northern side of the site in the vicinity of the drainage swale lithologic data shows that the upper five to twelve feet consists of clay and clayey sand. This layer is underlain by interbedded silt and silty sand to a depth of approximately 15 feet. This silt bed is unconformably underlain by a thin but continuous 1 to 2 foot thick bed of poorly sorted coarse sand. This coarse sand bed appears to increase in thickness to the east and may represent an ancestral stream channel. Between the depths of 16 feet and 28 feet the lithology consists of interbedded sand, silt, and clay. From the depth of about 28 feet to the total depth of the boreholes the lithology was predominantly sand and gravel representing the A-aquifer.

Hydrogeology

Three water bearing zones have been identified beneath the site and have been designated as the A-, B(1)-, and B(2)-aquifers in order of increasing depth. The current groundwater monitoring network consists of eleven A-aquifer and three B(1)-aquifer wells.

The A-aquifer, encountered between 25 and 35 feet is of variable thickness and is under confined conditions. The B(1)-aquifer, encountered between 47 and 56 feet, is separated from the A-aquifer by a clayey aquitard about seven feet thick. The B(2)-aquifer was encountered at one boring at a depth of 57 feet.

Permeability data collected during this investigation provided

information concerning the effectiveness of confining layers and aquitards. The permeability of the confining layer over the A-aquifer as measured at a depth of between 12 and 14 feet below grade was 2.4×10^{-4} cm/sec. The high values for this layer are attributed to the presence of root casts. The permeability of the aquitards separating the A-aquifer and B(1)-aquifer as measured at a depth of between 26 and 40 feet ranged from 2.8×10^{-6} to 3.1×10^{-7} cm/sec. The permeability of the aquitards beneath the B(1)-aquifer as measured at a depth of 56 to 58 feet below grade ranged from 2.9×10^{-7} to 2.3×10^{-8} cm/sec (5.7×10^{-7} to 4.5×10^{-8} ft/min).

The direction of groundwater flow in the A- and B(1)-aquifers is predominantly to the north-northeast (toward the San Francisco Bay) at a gradient of approximately 0.004 ft/ft (vertical feet per linear foot). The direction of groundwater flow in the B(2)-aquifer is presumed to be in a similar direction as the two shallower aquifers. Groundwater flow within the A-aquifer has been affected by the extraction of groundwater from monitor well V-4. The groundwater flow pattern also suggests that flow within the A-aquifer in the vicinity of the site may be preferentially along the path of an ancestral stream channel. Flow within the B(1)-aquifer is in a more regional and predominantly northerly direction.

The average value of the horizontal hydraulic conductivity of the A-aquifer as measured by the constant rate discharge test at monitor well V-4 was 7.9×10^{-2} ft/min. This figure is an average of calculations based upon the Hantush-Jacob method for leaky confined aquifers, the Jacob straight line method for bounded aquifers with a short distance between the pumping and observation well, and the Jacob solution for recovery data. The average value of transmissivity was 5.53×10^{-2} ft²/min and the average value of storativity was 1.52×10^{-3} . The slug test yielded variable values of aquifer parameters in the vicinity of the other A-aquifer monitor wells. Transmissivity ranged from a high of 7.18×10^{-1}

ft²/min at monitor well V-6 to a low of 1.98×10^{-3} ft²/min at monitor well V-5. The values for hydraulic conductivity followed a similar pattern with a high of 1×10^{-1} ft/min at monitor well V-6 and a low of 6×10^{-4} ft/min at monitor well V-5. Values of storativity ranged from a high of 3.67×10^{-2} at monitor well V-2 to a low of 5.88×10^{-10} at monitor well V-1.

2.4 Nature and Extent of Contamination

Numerous studies have been used to characterize the nature and extent of contamination at the site. A detailed description of these investigations and their results is presented in the draft Remedial Investigation (OHM 1990) and in the Feasibility Study (OHM 1991). Maximum concentrations detected at the site in soil and groundwater are presented in Tables 1 and 2, respectively. Figures 1 through 4 present concentrations detected at sampling locations across the site. The total mass of soil that is estimated to be contaminated is 750 cubic yards.

Soil

Chemicals are present in site soils but except in a few hotspots, are generally present at low levels and occur infrequently. The major area of contamination that was used as the basis for the Jacobs (1989) EA has been remediated. Concentrations detected in this area are presented in Figure 3. In the area of the drainage swale located north and east of the excavated site and bounded to the south by the concrete pad and to the north by the railroad ballast, target constituents were detected from the depth of three feet to the depth of groundwater (Figure 1). Maximum concentrations detected in this area are:

<u>CONSTITUENT</u>	<u>MAX. CONCENTRATION</u>	<u>DEPTH</u>
1,1-DCA	3.0 mg/kg	30'
1,1-DCE	1.7 mg/kg	5'
1,2-DCE	0.015 mg/kg	25'
1,1,1-TCA	61.0 mg/kg	5'
acetone	8.8 mg/kg (May, 1988)	3'
bromoform	0.17 mg/kg	25'

methylene chloride	4.2 mg/kg	20'
tetrachloroethene	4.0 mg/kg	25'
trichloroethene	0.015 mg/kg	3'

These results are from analyses conducted between June and July of 1990 except for acetone which represents analyses conducted in May of 1988. Acetone was not detected in the June/July 1990 sampling round.

To the west of the excavated area, the presence of halogenated volatile organic constituents appears to be limited to an area extending from the block wall ten feet north and bounded to the east by the area of interim soil excavation and extending to the west approximately 160 feet. Figures 2 and 4 provide the concentrations and locations of samples collected in this area. Soil samples collected below a depth of three feet at the boreholes located greater than ten feet north of the block wall did not contain any halogenated volatile organic constituents. Maximum concentration detected in this area are:

<u>CONSTITUENT</u>	<u>MAX. CONC. (Date)</u>	<u>DEPTH</u>
1,1-DCA	0.61 mg/kg (5/88)	3'
1,1,1-TCA	0.44 mg/kg (5/88)	3'
methylene chloride	6.2 mg/kg (5/88)	3'
tetrachloroethylene	0.24 mg/kg (5/88)	3'

Of the samples collected from this area in the June/July 1990 sampling round, the only halogenated volatile organic constituents which were detected at concentrations above detection limits were tetrachloroethylene (0.005 mg/kg in S-5) and 1,1,1-TCA (0.014 mg/kg in C-3).

Groundwater

Maximum concentrations of chemicals detected in groundwater at the site are presented in Table 2. In general, the greatest number and highest concentrations of chemicals have been detected in monitoring wells V-2 (which has been destroyed) and V-4, both of

which are or were located at the northwest corner of the production facility (Figure 5). Monitoring wells V-1 and V-3 at the northern portion of the underground storage tank area and the southwestern corner of the production facility have the next highest levels of chemicals.

At present, based upon the results of analyses conducted in April and July of 1990, the only non-halogenated volatile organic constituent present in A-aquifer groundwater is high boiling point hydrocarbons. During July 1990, high boiling point hydrocarbons were only detected at monitor wells V-1 (0.65 mg/l), V-3 (0.15 mg/l), and V-4 (0.35 mg/l).

Pentachlorophenol and 4-Nitrophenol were detected in groundwater collected from monitoring well V-1 in April 1990 at concentrations of 0.023 mg/l and 0.037 mg/l, respectively. Samples collected from this well in July 1990 and prior to April 1990 did not contain detectable levels of these constituents, except that pentachlorophenol was detected at 0.0002 mg/l in July 1984. Pentachlorophenol was reportedly detected at 0.05 mg/l in well V-3 in November 1987 but was not detected at any other time in this well or in other wells.

The only target constituents detected in groundwater samples from the B(1)-aquifer during the July 1990 sampling were 1,1,1-trichloroethane (0.003 mg/l), 1,1-dichloroethane (0.003 mg/l), and 1,1-dichloroethene (0.002 mg/l) at monitoring well I-2 and phenol (0.0036 mg/l) at monitoring well I-3. Figure 6 provides the locations of these wells. No target constituents have been detected in groundwater samples collected from monitoring well I-1 located at the eastern edge of the former drainage swale area during the last four sampling phases. The presence of volatile organic constituents in groundwater collected from monitoring well I-2, directly downgradient from the former drainage swale area, has been relatively constant over recent sampling phases.

Phenol was detected in the groundwater sample collected from monitoring well I-3 in July 1990 at a concentration of 0.0036 mg/l. Phenol had been detected at 0.02 mg/l in groundwater collected from this well in September 1987 but had not been detected in subsequent sampling rounds.

The source of the constituents in the B(1)-aquifer are uncertain. It is possible that target constituents may have migrated from potential source areas through the overlying vadose zone soil, the A-aquifer and the aquitard separating the A- and B(1)-aquifers. More likely migration pathways include the downward movement of A-aquifer groundwater along wells completed into the B(1)-aquifer at the time of installation or migration within wells with screened intervals which bridge the aquitard separating the two uppermost aquifers.

3.0 CHARACTERISTICS OF KEY CHEMICALS

The Jacobs (1989) EA identified the key site chemicals as:

Benzene	Tetrachloroethene
1,1-Dichloroethane	Trichloroethene
1,2 Dichloroethane	Vinyl Chloride
1,1-Dichloroethene	Pentachlorophenol
Methylene Chloride	

Further review of data collected subsequent to the EA suggests that 1,1,1-trichloroethane, which has been detected at elevated concentrations in groundwater and in soils should also be included as a key site chemical. Pentachlorophenol (PCP) has not been detected in site soils in any recent sampling and was only detected in one groundwater sample at a level slightly above detection limits. PCP was detected in this well in April 1990 but not in July 1990 and not in other sampling rounds. Based on its very infrequent detection and low concentration, the total mass of PCP would seem to be too low to pose a health concern. In addition, the Jacobs EA indicated that PCP did not pose a potential health risk under the scenarios considered in their assessment. Consequently, PCP will not be considered a key chemical for remediation.

Petroleum-derived aliphatic compounds (diesel, paint and laquer thinners, low-high boiling point hydrocarbons), alcohols, and ketones were all detected in site soils. These chemicals have similar environmental behavior to the halogenated VOCs selected by Jacobs (1989) as key chemicals, but are generally less toxic than these chemicals. Consequently, cleanup criteria developed for the halogenated VOCs will be protective for the non-halogenated compounds.

The key chemicals for assessing remedial action at the Jasco Site are:

Benzene	Tetrachloroethene
1,1-Dichloroethane	1,1,1-Trichloroethane

1,2 Dichloroethane
1,1-Dichloroethene
Methylene Chloride

Trichloroethene
Vinyl Chloride

Actions taken to remediate these chemicals should also control the small amounts of other chemicals, including the petroleum-based compounds, that are present at the site.

3.1 Environmental Fate and Transport

The environmental behavior of a particular chemical is dependent on the physical and chemical properties of the compound, the environmental transformation processes affecting them, and properties of the media in which it is located. Because the potential for exposure is highly dependent on the fate and transport of the chemicals of concern, these characteristics are discussed as part of the risk assessment. Chemicals of concern at the site include halogenated volatile organic compounds (VOCs) such as methylene chloride, chloroform, and tetrachloroethylene; total petroleum hydrocarbons (TPH); and monocyclic aromatic hydrocarbons (benzene, toluene, xylene, and ethylbenzene; BTXE). The properties of these chemicals are summarized below.

Volatile Organic Compounds

The volatile organic chemicals (VOCs) generally have relatively low organic carbon partition coefficients (K_{oc} s) indicating they are not likely to adsorb to the soil organic matter. Most of these chemicals have solubilities in the hundreds-of-milligrams-per-liter range or greater (approximately 15,000 mg/liter or ppm for methylene chloride) and are expected to be fairly mobile in the aqueous phase (i.e. once they become dissolved in groundwater). Once in the groundwater, soluble organic chemicals are transported in the direction of groundwater flow, but at a slower rate than groundwater. This is because chemicals moving in groundwater partition between the mobile medium (groundwater) and the stationary medium (soil particles). The overall effect of this

adsorption-desorption process is a reduction in the rate of a chemical's transport relative to the groundwater flow velocity.

Laboratory studies and field observations have shown that chlorinated aliphatic hydrocarbons can undergo both biological and abiological (physicochemical) transformations in soil and groundwater under the right conditions.

The halogenated VOCs are rather volatile and are likely to be released from uncovered vadose zone soils into the ambient air. The potential for compounds to volatilize from exposed subsurface soils can be predicted by their vapor pressure and/or Henry's Law constants, with compounds having high vapor pressures or Henry's Law constants generally volatilizing readily.

3.2 Toxicity/Hazard Evaluation

Brief descriptions of the toxic effects of the key site chemicals is presented in the Jacobs' EA and this information is not repeated in this report. Oral toxicity criteria (Cancer slope factors for carcinogens and reference doses for noncarcinogens) are presented in Table 3. In order to establish media-specific toxicity criteria, an allowable exposure dose or target dose must be determined. For carcinogens, the target dose is generally a dose associated with a cancer risk range of 10^{-4} - 10^{-6} , with the 10^{-6} dose level generally used as the target dose. For noncarcinogens, the verified reference dose (RfD) is used as the target dose. Target doses for the key chemicals are also presented in Table 3.

Media-specific toxicity criteria can be developed based on the target doses by using standard EPA assumptions. For establishing criteria for usable groundwater (i.e., water that can be used as a potable water supply), EPA assumes that the average person weighs 70 kg and drinks 2 liters of water per day. This approach is used

by the EPA Office of Drinking Water to develop MCLGs and MCLs. The EPA Office of Drinking Water Maximum Contaminant Level (MCL) values, if available, are presented in Table 4. Criteria developed using the target doses together with the assumptions listed above are also presented in this table.

4.0 CLEANUP LEVEL DEVELOPMENT

4.1 Exposure and Risk Assessment

The conclusions of the Jacobs (1989) EA are that:

- o The site does not pose a significant health risk under current land-use conditions. The only complete exposure route was determined to be inhalation of volatile compounds and the potential cancer risk was determined to be less than 10^{-6} .
- o Under future land-use conditions, the site could pose a significant risk via ingestion and inhalation of volatile compounds in groundwater used for domestic purposes. Jacobs (1989) estimated that a maximum plausible excess cancer risk of 4×10^{-3} for ingestion and 6×10^{-4} for vapor inhalation would be associated with use of groundwater in the A aquifer for domestic water supply.
- o Use of groundwater for domestic purposes would also pose significant non-carcinogenic risks.
- o Risks associated with exposure to contaminated soil by ingestion of surface soil or inhalation of fugitive dust were not significant.

OHM reviewed the Jacobs (1989) Endangerment Assessment and generally concurs with the conclusions of the report that the site does not currently pose a significant health risk but that under certain conditions, future use could pose a significant risk. The total mass of chemicals present in site soils was estimated by Jacobs to be too small to pose a risk as a result of inhalation exposure. The volatile chemicals present in site soils would not persist in surface soils and consequently are unlikely to be contacted by children with any regularity. These soils are also located immediately adjacent to the railroad tracks and will probably not be disturbed during any future construction.

Based on this EA, only the use of groundwater as a drinking water

source was evaluated in detail in establishing cleanup criteria for chemicals at the Jasco site. Exposure to chemicals released into a residential dwelling constructed on site was not considered in the Jacobs (1989) report but will be addressed in this assessment.

Groundwater

As noted in the Jacobs (1989) Endangerment Assessment, groundwater in the upper aquifers (A and B1) in the area of the Jasco site is not currently used for domestic water supply. Under current conditions, Jacobs (1989) noted that site chemicals in groundwater did not pose a public health risk. However, use of the site could change in the future particularly as the area has been rezoned to residential use.

Exposure to materials from the site through use of contaminated groundwater requires that 1. the material is able to migrate through site soils in significant quantities or is present in the groundwater, 2. any groundwater this material contacts is of sufficient quantity and quality to be used as a groundwater source, and 3. the groundwater is used as a potable water supply well. Certain halogenated volatile organic compounds and lighter petroleum hydrocarbons have migrated to A-aquifer groundwater and in at least one location to the B(1)-aquifer. In addition, other organic compounds present in the vadose zone at the site could also migrate to these groundwater aquifers under certain conditions. The presence of root casts and sandy interbeds provide an effective pathway for the vertical migration of target constituents to the A-aquifer. Lateral migration of target constituents in the vadose zone soil has occurred within the continuous coarse sand interbed about 15 feet below grade and along other discontinuous sandy interbeds. In the former drainage swale area and in on-site areas, downward percolation of precipitation and runoff is currently limited by the runoff collection system which directs runoff to the local sewer system.

Migration of dissolved halogenated volatile organic constituents in a northerly direction has occurred within the A-aquifer. Migration of target constituents from the drainage swale area appears to be limited to the more mobile chlorinated hydrocarbons such as 1,1,1-TCA, 1,1-DCA, 1,1-DCE and acetone. Less mobile target constituents such as petroleum hydrocarbon mixtures have not been detected in monitoring wells downgradient from the former drainage swale and underground storage tank areas.

The distribution of target constituents in the B(1)-aquifer suggests that the release occurred through a man-made conduit. A plume of three volatile organic constituents is currently centered downgradient of the former drainage swale area and the permeability of the aquitard separating the A- and B(1)-aquifers is such that vertical migration is unlikely. The lateral continuity of this aquitard both on site and at downgradient locations was established during the installation of the B(1)-aquifer wells. Lateral migration of target constituents within the B(1)-aquifer appears to be limited to the slow downgradient migration of the halogenated volatile organic constituents now centered at monitoring well I-2. The low permeability of the aquitard underlying the B(1)-aquifer and the lack of a nearby potential conduit makes vertical migration to underlying aquifers unlikely.

Use of the A and B(1) aquifers is generally restricted in order to prevent subsidence. In addition, a sample collected in May 1987 from the A-aquifer (well V-3) by Wahler Associates had levels of total dissolved solids (TDS; 3,100 mg/l) that slightly exceeded the TDS value of 3,000 mg/l that is used as a criteria under California's Proposition 65 for determining if water is a "source of drinking water." Primary drinking water standards (Maximum Contaminant Levels or MCLs) were exceeded for turbidity (130 NTU vs. MCL of 0.5-1 NTU) and coliform bacteria were detected in the water. The water also exceeded Secondary Drinking Water Standards for TDS (3,100 mg/liter vs. standard of 500 mg/l), chloride (540

mg/l vs. standard of 250 mg/l), color (30 color units vs. standard of 15 color units), iron (0.56 vs. standard of 0.3 mg/l) and manganese (4.5 mg/l vs. standard of 0.05 mg/l). Based on these results, the water in the A-aquifer appears to be of rather poor quality and would not be usable as a drinking water source without substantial treatment.

4.2 Risk-Based Cleanup Levels

Groundwater

Jacobs (1989) modelled the migration of chemicals at the Jasco site using two models. The first model was a one dimensional analytical model that was used to evaluate the downward leaching of chemicals from vadose zone soils into the A-aquifer. A numerical model, SUTRA, was then used to model the downgradient migration of chemicals in the A-aquifer. The leaching model was developed based on the ratio of the maximum concentrations of methylene chloride in soil and groundwater. The concentration of other chemicals was then determined based on this ratio by using the highest value in soil or groundwater and the dilution factor from methylene chloride. The Jacobs (1989) modelling used data that included the heavily contaminated area of the drainage swale that was remediated in 1987.

The estimated groundwater concentration was then used as input into the numerical model to evaluate the migration in the A-aquifer. This model accounts for changes in concentration associated with horizontal and vertical dispersion of the plume in the aquifer and migration of the plume past a point of exposure.

Target risk-based groundwater criteria and MCLs (which consider both risk and technical feasibility) for key chemicals are presented in Table 4. These values were used, together with the dilution factors from the Jacobs (1989) modelling effort, to determine allowable levels of chemicals in site soils. These

values are presented in Table 5. In all cases the values based on the MCLs are higher than the values based on the target risk-based criteria alone. EPA considers attainability in preparing MCLs and this fact is probably responsible for the differences. Both values represent levels of exposure that are considered to be "safe" by EPA.

The models used to estimate migration by Jacobs (1989) are considered likely to overestimate migration as neither model considers retardation or decay. Volatile organic compounds will not move at the same rate as water, but will be slowed somewhat by the process of adsorption to soil particles. Some of the compounds are expected to become tightly bound to these particles and may not be readily desorbed back into the water column. Steinberg et al (1987) studied ethylene dibromide (EDB), a volatile halogenated compound, in agricultural soils and noted that residual EDB (as opposed to freshly added EDB) at concentrations up to 200 ug/kg, appeared to persist in soils much longer than predicted by most models. They found that the EDB was being trapped very tightly in soil micropores. Other compounds have not been studied to date, but it is possible that some amount of the volatile organic compounds would be trapped by this same process. In addition, both biological and chemical degradation processes will act to break down the compounds. Considering these factors, the small amount of volatile organic compounds that would remain in soils may not reach groundwater and if they reach groundwater may not reach a potential exposure point.

Indoor Air Exposure

Jacobs (1989) evaluated the potential risks associated with exposure to outdoor air at the Jasco site but did not consider the potential for indoor air exposure. For completeness, a qualitative evaluation of this pathway was included as part of this report.

Jacobs (1989) estimated the amount of each chemical present at the

site and assumed that all this material would volatilize over a lifetime. Based on this analysis, they determined that the site did not pose a health risk for outdoor exposure. EPA (1989), in the Air/Superfund National Technical Guidance Study Series, estimated that 130 mg/m²-min is a reasonable estimate of volatile emissions from surface material while 0.4 mg/m²-min was determined to be a reasonable estimate of emissions from covered soils. Any residential structure that in the future is placed on the current Jasco property would almost certainly have a concrete floor which will be of rather low permeability. Chemicals in soils will tend to move to areas of higher permeability, and consequently, will tend to be released into outdoor areas. Over time, small cracks will occur in the concrete flooring and some migration of chemicals through these cracks could occur. However, considering the wide dispersion of chemicals on site and the low levels that will remain following remediation, it is unlikely that exposure via this pathway would pose a greater risk than that estimated by Jacobs (1989) for outdoor exposure to the entire mass of chemical.

4.3 Cleanup Guidelines for Other Sites

The California Regional Water Quality Control Board generally requires cleanup of volatile organic compounds (VOCs) to soil levels of approximately 0.5 to 1 mg/kg, based on the assumption that this level is unlikely to adversely affect water. Higher levels have been allowed on a case-by-case basis. This value is similar to the state of New Jersey ECRA criteria for VOCs of 1 mg/kg.

EPA (1990), in their proposed Corrective Action Rule for Solid Waste Management Units (40 CFR 264), presented examples of concentrations meeting criteria for action levels at solid waste management units (SWMUs) in several media including soils. The criteria for soils were developed based only on a consideration of soil ingestion and are inappropriate for volatile compounds which will generally not persist in soils that could be ingested (i.e.,

surface soils. These action levels also do not consider risks that could be associated with volatilization of the chemicals or leaching to groundwater. The action levels, which are risk-based and correspond to 10^{-6} cancer risk levels or to reference dose levels, range from 8 mg/kg for 1,2-dichloroethane to 7,000 for 1,1,1-trichloroethane. Values were not presented for benzene or vinyl chloride. As noted, these values are inappropriate for this site but do indicate that the proposed site-specific cleanup levels would be protective for direct contact exposures.

4.4 Soil Remediation Levels for the Jasco Site

In developing site-specific cleanup criteria for soils at the Jasco site, Jacobs (1989) did not evaluate the effects of retardation or degradation of the chemicals. A certain amount of the chemicals present in soils at the Jasco site are likely to be retained by soil carbon or in soil particle micropores or will be chemically degraded or degraded by soil microorganisms. Only small areas of the site contain chemicals, particularly following the excavation of the drainage swale area. Because the modelling effort assumed a larger area of the site was contaminated, the actual amount of dilution that would occur is likely to be greater than predicted by the Jacobs (1989) model.

Based on the potential effects of retardation, microbial and chemical degradation, and dilution, higher levels of VOCs than presented in Table 5 are considered unlikely to pose a health risk at the site. OHM proposes that a cleanup criteria (soil remediation level) of 1 mg/kg be used for all the carcinogenic volatile organic compounds except for vinyl chloride, which is a potent known human carcinogen. For vinyl chloride, OHM proposes a soil remediation level of 0.5 mg/kg. In order to protect against the effects of multiple exposure to chemicals, including those not considered as key site chemicals, OHM proposes that the total level of carcinogenic volatile organic compounds not exceed 5 mg/kg in

soils.

For 1,1,1-trichloroethane, the only noncarcinogenic halogenated VOC, OHM proposes a soil remediation level of 50 mg/kg. This level is below any health-based criteria but is more consistent with values presented in the California Leaking Underground Fuel Tank Manual for other similar noncarcinogenic compounds such as toluene, xylene, and ethylbenzene. Other noncarcinogenic compounds that have been detected at the site primarily consist of the low to medium boiling point petroleum hydrocarbons. These compounds tend to be less mobile, more rapidly degraded, and in most cases less toxic than 1,1,1-trichloroethane. Consequently, OHM proposes that a soil remediation level of 50 mg/kg be used for these noncarcinogenic compounds. OHM also proposes that the total concentration of noncarcinogenic compounds not exceed 100 mg/kg. This level should be sufficient to protect against any adverse effects from mixtures of compounds, including mixtures of petroleum hydrocarbons.

Based on groundwater modelling conducted for the Endangerment Assessment, organic site constituents at the soil remediation levels noted above are unlikely to pose risks to individuals using the water in the A-aquifer as a drinking water source. The modelling conducted as part of the Jacobs Endangerment Assessment assumed that the chemicals of concern were present in soils at a uniform concentration. Because the dilution factors used in this assessment were based on this assumption, chemicals present in soils at levels slightly above the soil remediation criteria would probably not pose a health concern as long as the average concentration of the chemical in a particular area was below the criteria. Further considering that water from the A-aquifer would probably not be used for domestic purposes because of its poor quality and the restrictions placed on its use by local agencies, low levels of chemicals remaining in site soils are unlikely to pose a substantial health risk.

5.0 CONCLUSIONS

Soil remediation levels have been developed for the Jasco site that are designed to adequately protect future on-site and nearby off-site residents from any potential health effects associated with the migration of chemicals in soils into groundwater that could be used as a domestic water source. These soil cleanup levels are:

Carcinogens

Individual volatile organic compounds - 1 mg/kg

Vinyl Chloride - 0.5 mg/kg

Sum of all compounds - 5 mg/kg

Noncarcinogens

Individual volatile organic compounds - 50 mg/kg

Sum of all compounds - 100 mg/kg

Cleanup levels for these compounds were developed based on a comparison with cleanup criteria used for other sites and a consideration of site-specific factors, including the potential for migration and the small amount of material present. The poor quality of the water in the A-aquifer and the restrictions placed on the use of this water by local agencies were not considered in developing the soil remediation levels but support .

In order to ensure that the health of on-site and off-site workers and any nearby residents is adequately protected, conservative (health protective; unlikely to underestimate risk) assumptions were used in deriving these soil remediation levels. Because of the use of these conservative (although not necessarily worst case) assumptions, it is unlikely that chemicals remaining at the site at these levels would pose an actual hazard.

6.0 References

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TABLE 1

MAXIMUM SOIL CONCENTRATIONS DETECTED
AT JASCO CHEMICAL CORPORATION

Contaminant	Highest Detected Concentration (mg/kg)	Date Sample Collected
Acetone	100 (270) ^a	1988 SB-10(B-8)
Benzene	0.008 (3)	1987 (Excavation)
Carbon Tetrachloride	ND (680)	1988 (B-8)
Chloroform	ND (2.3)	1988 (B-8)
1,1-Dichloroethane	3 (34)	1988 C-1(B-8)
1,1-Dichloroethene	1.7 (34)	1988 C-1(B-8)
1,2-Dichloroethane	ND (3.9)	1988 (B-8)
Ethanol	3.4 (20)	1988 SB-9(SB-3)
Ethylbenzene	14 (170)	1988 SB-12(B-8)
Isopropanol	164	1988 SB-9
Methanol	60	1990 C-1
Methylene Chloride	6.2 (3400)	1988 SB-9(E-8)
Methyl Ethyl Ketone	1.9	1988 SB-10
Petroleum Hydrocarbons as:		
Diesel	14	1988 B-12
Kerosene	10 (150)	1988 (SB-3)
Lacquer Thinner	10 (16)	1988 B-10(B-9)
Paint Thinner	7.3 (11,000)	1988 SB-10(B-8)
High Boiling Point	290	1990 S-1
Low to Med. Boiling Point	6700	1990 C-1
Tetrachloroethane	0.005 (16)	1988 S-4(B-8)
Tetrachloroethene	4	1990 C-1
Toluene	110 (1700)	1988 C-1(B-8)
1,1,1-Trichloroethane	61	1990 C-1
Trichloroethene	0.05 (490)	1988 C-1(B-8)
Xylene	37 (210)	1988 C-1(SB-4)

^a Values in parentheses are maximum values from the excavated area of the drainage swale. Soils containing these concentrations have been removed.

ND - Not Detected

TABLE 2

MAXIMUM GROUNDWATER CONCENTRATIONS DETECTED
JASCO CHEMICAL CORPORATION

<u>Contaminant</u>	<u>Highest Detected Concentration (mg/kg)</u>	<u>Date Sample Collected; Location</u>
Acetone	1.7	1989 V-4
Benzene	0.011 (0.02) ^a	1987 V-3(V-2)
Chlorobenzene	0.008 (0.037)	1987 V-4(V-2)
Chloroethane	0.39	1989 V-4
1,1-Dichloroethane	7.8	1989 V-4
1,1-Dichloroethene	0.19	1989 V-4
1,2-Dichloroethane	0.008	1987 V-4
Trans-1,2-Dichloroethene	0.2	1989 V-3
Ethanol	16	1989 V-4
Isopropanol	1.4	1989 V-4
Methanol	3.8	1990 V-3
Methyl Ethyl Ketone	(0.027)	1987 V-1(V-2)
Methylene Chloride	3.5 (142)	1987 V-4(V-2)
4-Nitrophenol	0.037	1990 V-1
Pentachlorophenol	0.05	1987 V-3
Phenol	0.02	1987 I-3
Toluene	0.017 (0.25)	1987 V-4(V-2)
Total Petroleum Hydrocarbons as:		
Diesel	33	1989 V-3
Paint Thinner	0.86	1984 V-1
1,1,1-Trichloroethane	1.7	1989 V-4
Vinyl Chloride	0.005	1990 V-4
Xylene	0.008 (0.05)	1987 V-3(V-2)

^a Values in parentheses are the maximum values detected in well V-2 which was destroyed during the on-site excavation.

TABLE 3

ORAL TOXICITY CRITERIA FOR
KEY CHEMICALS AT
JASCO CHEMICAL CORPORATION

<u>Chemical</u>	<u>Toxicity Criteria^a</u>	<u>Oral Target Dose^b</u>
<u>Carcinogens</u>	<u>Slope Factor (mg/kg/day)⁻¹</u>	<u>mg/kg/day</u>
Benzene	2.9×10^{-2} [A]	3.4×10^{-5}
1,1-Dichloroethane	9.1×10^{-2} [B2]	1×10^{-5}
1,2-Dichloroethane	9.1×10^{-2} [B2]	1×10^{-5}
1,1-Dichloroethene	6×10^{-1} [C]	1.7×10^{-6}
Methylene Chloride	7.5×10^{-3} [B2]	1.3×10^{-4}
Tetrachloroethene	5.1×10^{-2} [B2]	2×10^{-5}
Trichloroethene	1.1×10^{-2} [B2]	9×10^{-5}
Vinyl Chloride	2.3 [A]	4.3×10^{-7}
<u>Non Carcinogens</u>	<u>RfD mg/kg/day</u>	<u>mg/kg/day</u>
1,1,1-Trichloroethane	9×10^{-2}	9×10^{-2}

^a Toxicity criteria are the EPA slope factor (cancer potency factor) for carcinogens and the reference dose (RfD) for non carcinogens.

^b The oral target dose is the dose associated with a 10^{-6} cancer risk assuming lifetime exposure for carcinogens and is the RfD for non carcinogens.

TABLE 4
GROUNDWATER CRITERIA
FOR KEY CHEMICALS AT
JASCO CHEMICAL CORPORATION

Chemical	Risk-Based (mg/L) Concentration Based on Target Dose (Mg/L) ^a	MCL (mg/L) ^b
Benzene	0.0012	0.005
1,1-Dichloroethane	0.0004	NA ^c
1,2-Dichloroethane	0.0004	0.005
1,1-Dichloroethene	0.00006	0.007
Methylene Chloride	0.005	NA
Tetrachloroethene	0.0007	NA
1,1,1-Trichloroethane		0.2
Trichloroethene	0.003	0.005
Vinyl Chloride	0.00002	0.002

^a Value assumes the average person weighs 70 kg and drinks 2 liters of water/day. Value (mg/L) = oral target dose (mg/kg/day) x 70 kg / 2 L/day.

^b Maximum Contaminant Level (MCL) under the Safe Drinking Water Act.

^c Not available

TABLE 5

SOIL CLEANUP CRITERIA
FOR KEY CHEMICALS AT
JASCO CHEMICAL CORPORATION

Chemical	Dilution ^a Factor	Concentration Based on Target Dose (mg/kg) ^b	Concentration Based on MCL (mg/kg) ^b
Benzene	160	0.2	0.8
1,1-Dichloroethane	260	0.1	NA
1,2-Dichloroethane	360	0.1	2
1,1-Dichloroethene	240	0.01	2
Methylene Chloride	490	2	NA
Tetrachloroethene	290	0.2	NA
1,1,1,-Trichloroethane	400 ^c	1200	80
Trichloroethene	500	2	3
Vinyl Chloride	120	0.002	0.2

^a Source: Jacobs (1989); Fractional difference between on-site soil concentration (mg/kg) and modelled 70 year average groundwater concentration (mg/L).

^b Values defined by multiplying groundwater criteria from Table 4 by the dilution factor to determine allowable soil concentrations. Values do not account for attenuation on soil particles or chemical or biological degradation.

^c Estimated value

PLOT SCALE - 1"=30'

OHM CORPORATION
WALNUT CREEK, CA

DRAWN BY
E. Kwong 12-18-90

CHECKED BY

APPROVED BY

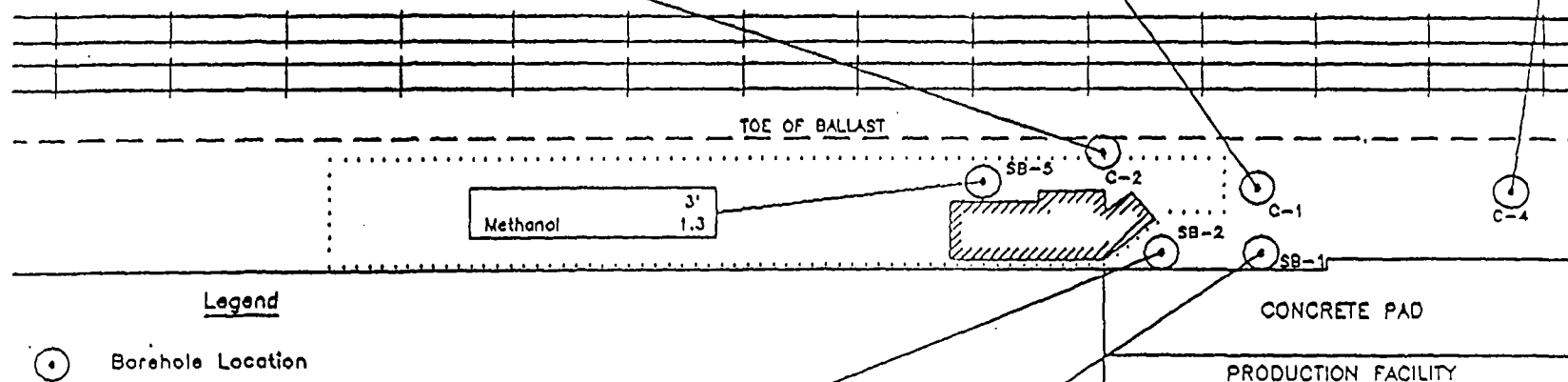
DRAWING
NUMBER 0007403-A4.4

CENTRAL EXPRESSWAY

	3'	5'	10'	15'	20'	25'	30'
1,1-DCA	0.02	0.018	0.036	0.11	0.083	0.41	ND
1,1-DCE	ND	ND	ND	0.03	ND	0.036	ND
1,2-DCE	ND	ND	ND	ND	ND	0.015	ND
1,1,1-TCA	0.099	0.052	0.016	0.095	0.052	0.016	ND
Bromoform	ND	ND	ND	ND	ND	0.019	ND
Methylene Chloride	ND	ND	0.14	0.27	0.71	ND	ND
Trichloroethene	0.015	ND	ND	0.0073	ND	ND	ND
Low-Med BP HC	ND	ND	ND	2800	1300	2600	ND
Toluene	0.023	ND	ND	0.005	ND	0.063	0.018
Xylene	ND	ND	ND	0.01	ND	0.038	0.028

	3'	5'	10'	15'	20'	25'	30'
1,1-DCA	0.12	0.38	0.038	NO	0.72	2.2	3
1,1-DCE	0.39	1.7	0.025	0.17	0.24	0.15	ND
1,1,1-TCA	15	61	0.59	5.3	6.8	ND	ND
Bromoform	ND	ND	ND	ND	ND	0.17	0.11
Methylene Chloride	0.9	ND	0.75	ND	4.2	3.2	ND
Tetrachloroethene	ND	0.065	ND	0.052	ND	4	ND
Trichloroethene	ND	0.05	ND	ND	ND	ND	ND
Isopropanol	76	ND	ND	ND	ND	ND	ND
Methanol	60	ND	ND	ND	ND	ND	ND
Low-Med BPHC	2800	8700	170	1300	120	380	38
Toluene	37	110	1.1	3.4	4.1	6.3	1.4
Xylene	11	37	0.87	5.5	2.6	5.9	1.5
Ethylbenzene	ND	ND	ND	ND	ND	ND	0.37

No concentrations
exceeding detection
limit.



Legend

- Borehole Location
- Impermeable Membrane Runoff Collection System
- //// Area of Interim Soil Excavation
- All concentrations of contaminants given in mg/kg

	3'
1,1-DCA	1.4
1,1,1-TCA	2.6
Acetone	6.3
Methylene Chloride	1.7
Toluene	0.3
Acetone	8.8
Methanol	5.0
TPH (Kerosene)	10
TPH (Paint Thinner)	5.2

	3'
1,1-DCA	0.54
1,1,1-TCA	1.1
Methylene Chloride	1.3
Acetone	1.1
Ethanol	0.7
Methanol	3.3

FIGURE 1
DISTRIBUTION OF TARGET CONSTITUENTS
3-30', FORMER DRAINAGE SWALE, DS-1

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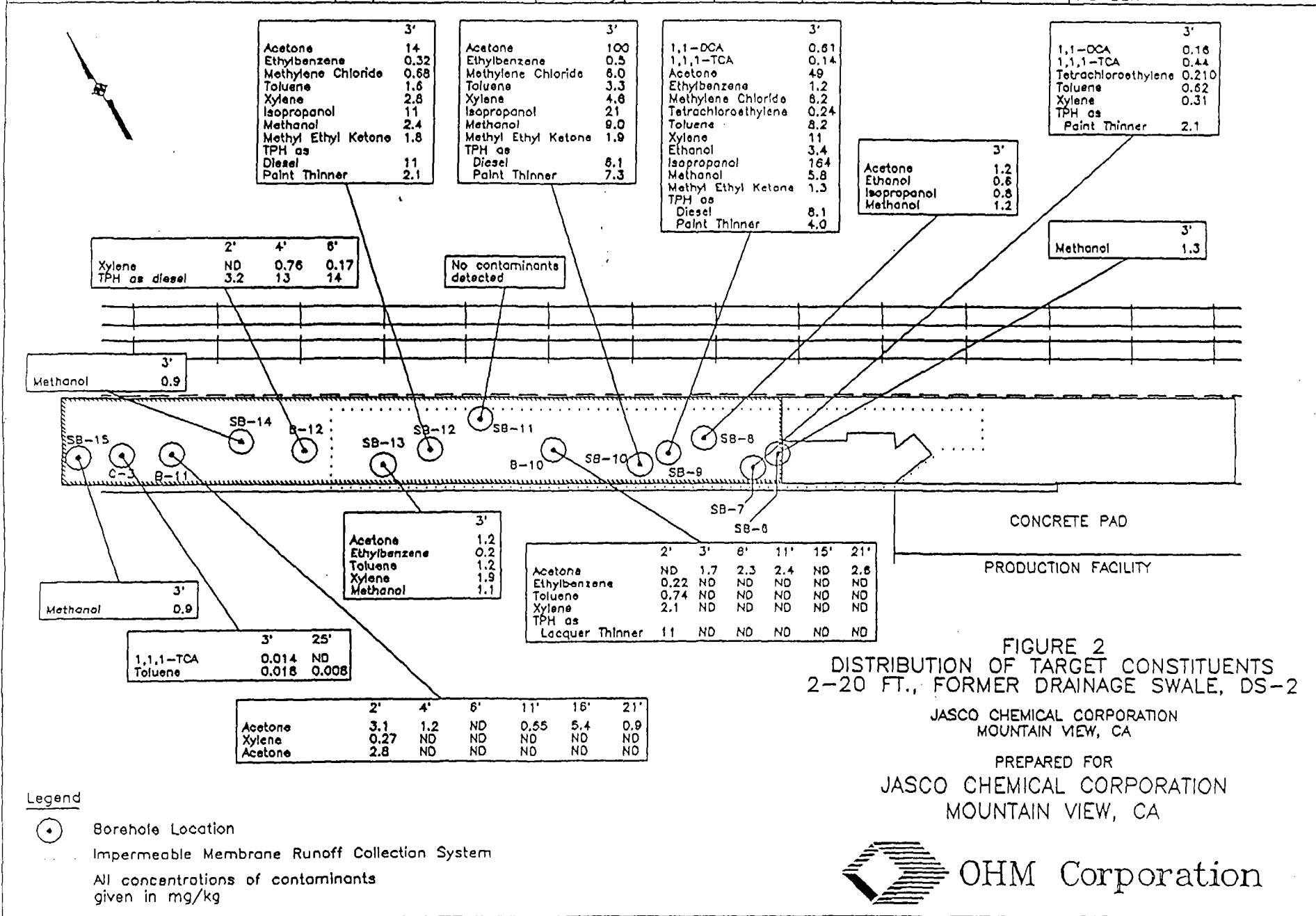



FIGURE 2
DISTRIBUTION OF TARGET CONSTITUENTS
2-20 FT., FORMER DRAINAGE SWALE, DS-2

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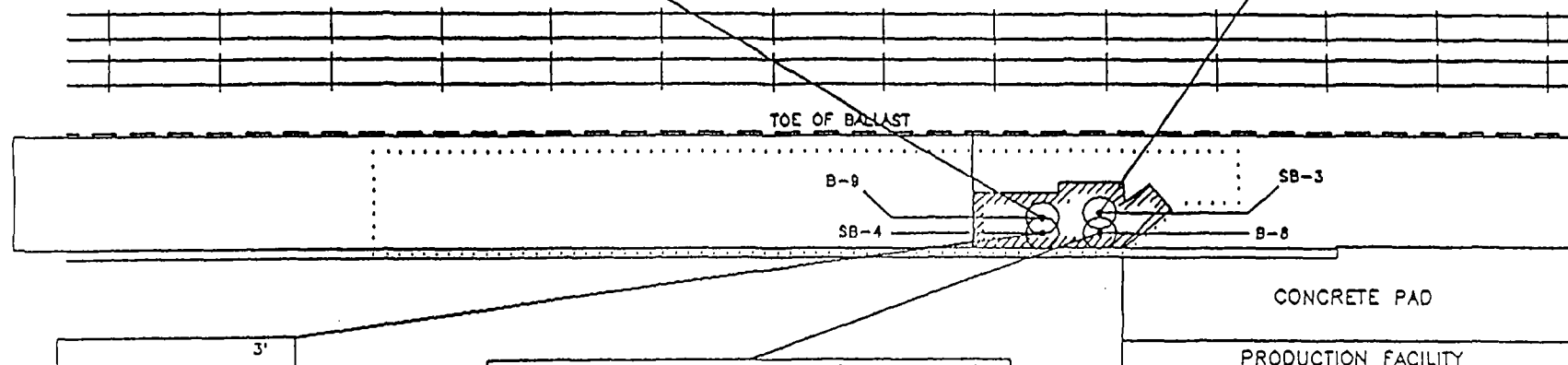
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PLOT SCALE = 1"=30'

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	2'	4'	6'	11'	16'	21'
1,1-DCA	ND	2.2	0.80	0.23	ND	ND
1,1-DCE	0.16	ND	ND	ND	ND	ND
1,1,1-TCA	0.34	30	28	0.29	ND	ND
2-Propanone	24	25	6.2	5.1	ND	ND
Bromodichloromethane	0.16	ND	ND	ND	ND	ND
Ethylbenzene	ND	3	4.2	ND	ND	ND
Methylene Chloride	9.3	42	21	7.4	18	15
Tetrachloroethane	ND	0.87	1.3	ND	ND	ND
TCE	ND	1.4	1.5	ND	ND	ND
Toluene	2.3	38	41	0.27	ND	ND
Xylene	0.45	18	27	ND	ND	ND
Acetone	16	25	1.8	27	12	4
Isopropanol	ND	1.5	ND	ND	ND	ND
TPH as						
Lacquer Thinner	18	ND	ND	ND	ND	ND
Paint Thinner	98	5000	2000	29	ND	ND

	3'
1,1,1-TCA	47
Acetone	91
Methylene Chloride	210
Toluene	36
Xylene	27
Ethanol	20
Isopropanol	18
Methanol	32
TPH as	
Kerosene	150
Paint Thinner	320



	3'
1,1-DCA	1.2
1,1,1-TCA	7.3
Acetone	28
Ethylbenzene	2.2
Methylene Chloride	64
Tetrachloroethylene	1.0
TCE	0.56
Toluene	17
Xylene	210
Isopropanol	60
Methanol	14
TPH as	
Kerosene	140
Paint Thinner	320

	3'	5'	10'	15'	20'
1,1-DCA	27	34	0.98	0.2	0.78
1,1-DCE	13	ND	ND	ND	ND
1,1,1-TCA	ND	1.5	22	2.3	0.21
1,2-DCA	3.9	ND	ND	ND	ND
Carbon Tetrachloride	650	ND	ND	ND	ND
Chloroform	2.3	ND	ND	ND	ND
Ethylbenzene	170	NA	NA	NA	NA
Methylene Chloride	3400	2.4	71	8.9	18
Tetrachloroethane	16	0.0067	0.31	ND	ND
TCE	490	ND	0.85	0.088	ND
Toluene	1700	NA	NA	NA	NA
Acetone	270	NA	13	NA	13
Isopropanol	3.5	NA	1	NA	2.5
TPH as					
Paint Thinner	11000	NA	2600	NA	20

Legend



Borehole Location

..... Impermeable Membrane Runoff Collection System

All concentrations of contaminants given in mg/kg

FIGURE 3
DISTRIBUTION OF TARGET CONSTITUENTS
2-30', FORMER DRAINAGE SWALE, DS-3

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APPENDIX D

EXPANDED EXTRACTION SYSTEM CALCULATIONS

Expanded Extraction System Calculations

The following methods were used to determine the range of extraction well systems which may be necessary to contain and treat groundwater at the site. The hydrogeologic parameters used in evaluating these systems have been collected in association with aquifer testing and groundwater extraction at existing monitor well V-4 which has been used as an extraction well since April of 1987. A submersible pump operating at a low continuous flow to limit drawdown is used to remove groundwater from the well. This groundwater is then directed through a plumbing system to the sanitary sewer system under Industrial Waste Discharge Permit 89037 as authorized by the City of Mountain View. Well V-4 was chosen for this purpose because of its proximity to the former drainage swale and its downgradient location from the production area and the underground storage tank area. This system has been in continuous operation since April 1987 with the exception of short periods for equipment maintenance.

The goal of a extraction system at the Site is to contain the flow of groundwater containing target constituents exceeding the ARARs and to direct this groundwater to extraction wells where it may be pumped from the aquifer and treated. Based upon the present distribution of target constituents in groundwater, this system must be effective at capturing groundwater passing beneath both the underground storage tank and former drainage swale areas. As the underground storage tank area is located upgradient from the former drainage swale area, the extraction system would be most effective in the vicinity of, or immediately downgradient of, the former drainage swale area. The effectiveness of extraction well systems can be estimated using research concerning capture zones for pumping centers [(EPA, 1986), (Javandel and Tsang,

1986), (Keeley and Tsang, 1983)]. The following is a discussion of the implementation of this research using site-specific data collected at monitor well V-4.

The following calculations should be considered only as approximations of the zone of capture. There are inherent limitations to the use of such models in the field. The accuracy of the calculations depend upon the accuracy of the estimates of aquifer characteristics. These conditions, however, may be variable based upon changes in the potentiometric surface or volume of groundwater recharge. In addition, these models assume a laterally and vertically homogeneous aquifer consistent with hydrogeologic conditions at the pumping well. Hydrogeologic conditions in the field are rarely homogeneous.

For the purpose of providing an estimate of the effectiveness of various groundwater extraction scenarios, a number of assumptions must be made:

- 1) The A-aquifer is a homogeneous aquifer with hydrogeologic parameters as estimated at monitor well V-4 from aquifer tests conducted during previous investigations. These parameters are listed below:

A-aquifer saturated thickness (b)	= 7 feet
hydraulic conductivity (K)	= 167.4 gal/day/ft ²
hydraulic gradient (dh/dl)	= 0.004 ft/ft
transmissivity (T) = (K) x (b)	= 1171.8 gal/day/ft

- 2) Maximum sustainable discharge rates from the A-aquifer range from 0.5 gallons per minute (720 gallons per day) to 2.4 gpm (3168 gallons per day). At present, due to the effects of the recent drought, the maximum sustainable discharge rate is assumed to be 0.5 gpm based upon pumping rates from monitor well V-4. The maximum sustainable

discharge rate from this well, prior to drought conditions, was 2.4 gpm.

3) The hydraulic gradient (dh/dl), based upon the historic potentiometric surface of the A-aquifer, is 0.004 ft/ft.

The variables in solving the equation of capture zones are:

Q = pumping rate (gal/day)
b = saturated thickness of aquifer (ft)
n = effective porosity
v = true pore velocity
K = hydraulic conductivity (gal/day/ft²)
 dh/dl = hydraulic gradient (ft/ft)
T = transmissivity (gal/day/ft)

The downgradient stagnation point (r_d) is the point in the downgradient direction from an extraction well where groundwater no longer flows to the well but rather in the direction of regional groundwater flow. Groundwater within the radius of r_d flows to the well. The relationship of r_d to the aquifer variables is:

$$r_d = \frac{Q}{(2 \times \pi) (b) (n) (v)}$$

This equation can be further defined for the variables which have been measured at the Site during past investigations using the following relationships:

$$v = (K/n) \times (dh/dl) \text{ and } K = \frac{T}{b}$$

By incorporating these relationships, the downgradient stagnation point can be estimated using:

$$r_d = \frac{Q}{(2 \times \pi) (b) (n) (K/n) (dh/dl)} \quad \text{or}$$

$$r_d = \frac{Q}{(2 \times \pi) (K) (b) (dh/dl)}$$

Solving for the downgradient stagnation point (r_d) assuming a pumping rate of 2.2 gallons per minute yields:

$$r_d = \frac{3168 \text{ gpd}}{(2 \times \pi) (167.4 \text{ gpd/ft}) (7 \text{ ft}) (0.004 \text{ ft/ft})} \quad \text{or}$$

$$r_d = 107 \text{ ft}$$

The cross gradient stagnation point (r_c) is the point perpendicular to the direction of groundwater flow from an extraction well where groundwater no longer flows to the well, but rather in the regional direction of groundwater flow. Groundwater within the radius of r_c flows to the well. The relationship of r_c to the aquifer variables is:

$$r_c = r_d \times \pi$$

Solving for Site conditions, assuming a pumping rate of 2.2 gallons per minute yields:

$$r_c = 107 \text{ ft} \times \pi$$

$$= 326 \text{ ft}$$

Using these estimates and assuming a constant discharge rate of 2.2 gallons per minute, a groundwater extraction system consisting of one well situated in the vicinity of existing monitor well V-4 would be capable of containing groundwater flow in the direction

of groundwater flow across the length of the former drainage swale area and the northern property boundary of JASCO (Figure 1).

As a result of drought conditions in the area between 1987 and 1990 the optimum discharge rate from monitor well V-4 has decreased. Should such conditions continue, a groundwater extraction system consisting of multiple wells may be required to provide a zone of capture which extends across the length of the former drainage swale area. At present the discharge rate from monitor well V-4 is approximately 0.5 gallons per minute (720 gallons per day). Solving the equations assuming a pumping rate of 0.5 gallons per minute results in the following results for r_d and r_c :

$$\begin{aligned} r_c &= 24.4 \text{ ft} \\ r_d &= 76.8 \text{ ft} \end{aligned}$$

Under such conditions, a single extraction well situated in the vicinity of monitor well V-4 would be capable of containing groundwater in the direction of groundwater flow across the eastern portion of the former drainage swale area (Figure 1). A multiple extraction well system may be necessary under such conditions to contain groundwater flow across the entire length of the former drainage swale area.

In an extraction system consisting of two extraction wells, the optimum distance between the two wells (d_2) can be calculated by:

$$\begin{aligned} d_2 &= \frac{Q}{(\pi) (K) (b) (dh/dl)} \\ &= \frac{720 \text{ gpd}}{(\pi) (167.4 \text{ gpd/ft}) (7 \text{ ft}) (0.004 \text{ ft/ft})} \end{aligned}$$

=

48.9 ft

Figure 2 shows the estimated zone of capture for an extraction system consisting of two wells separated by a distance of 48.9 feet. Such a system would be capable of containing groundwater in the direction of groundwater flow across nearly all of the former drainage swale area.

In an extraction system consisting of three extraction wells, the optimum distance between each well pair (d_3) is approximately 1.25 times the value of d_2 or 61.6 feet. Figure 3 shows the estimated zone of capture for an extraction system consisting of three wells separated by a distance of 61.6 feet. such a system should be capable of containing groundwater in the direction of regional groundwater flow across all of the former drainage swale area and nearly all of the northern property boundary of JASCO.

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PLOT SCALE: 1" = 110'

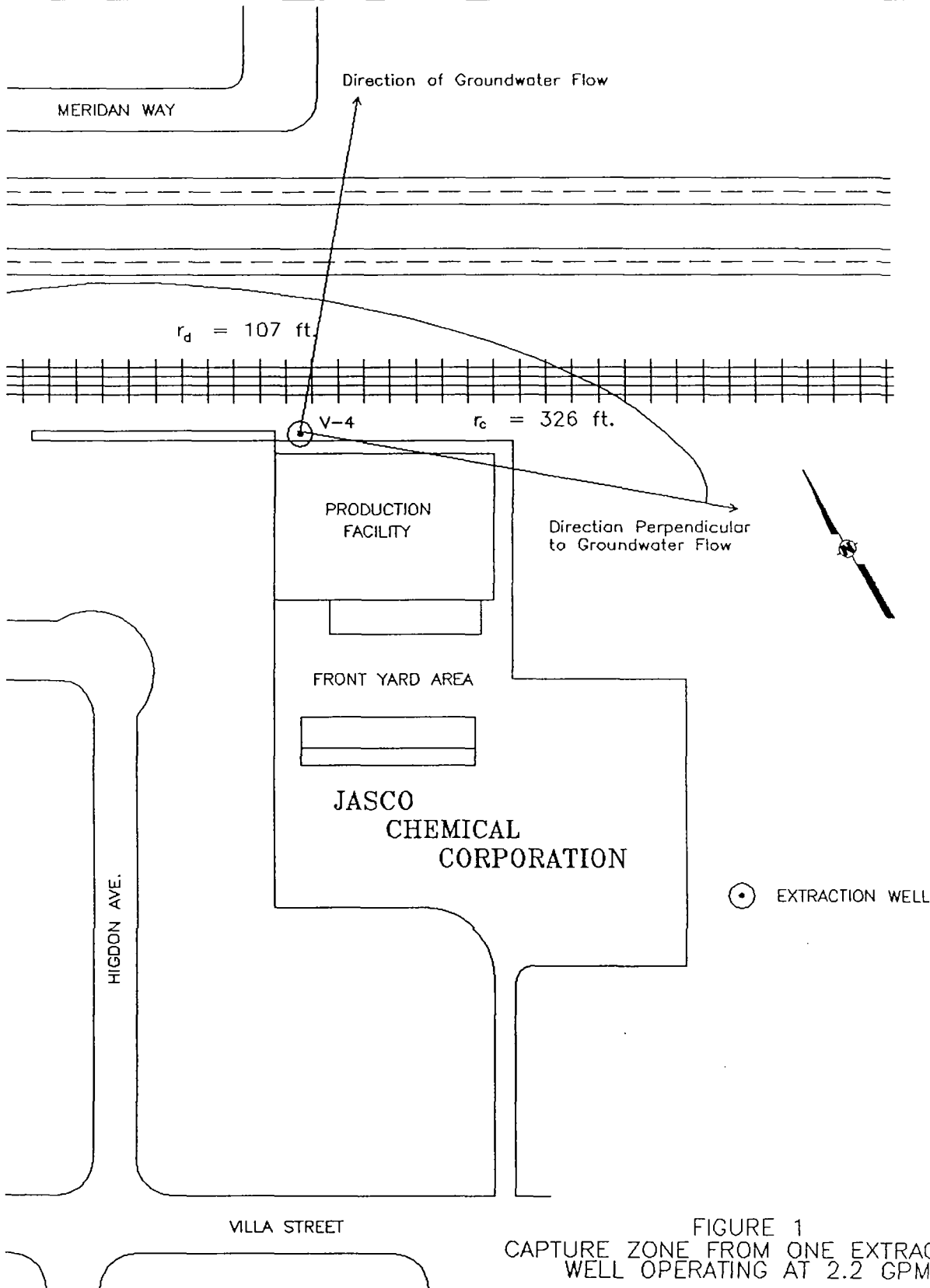
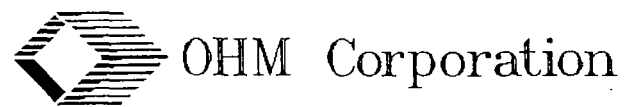


FIGURE 1
CAPTURE ZONE FROM ONE EXTRACTION
WELL OPERATING AT 2.2 GPM

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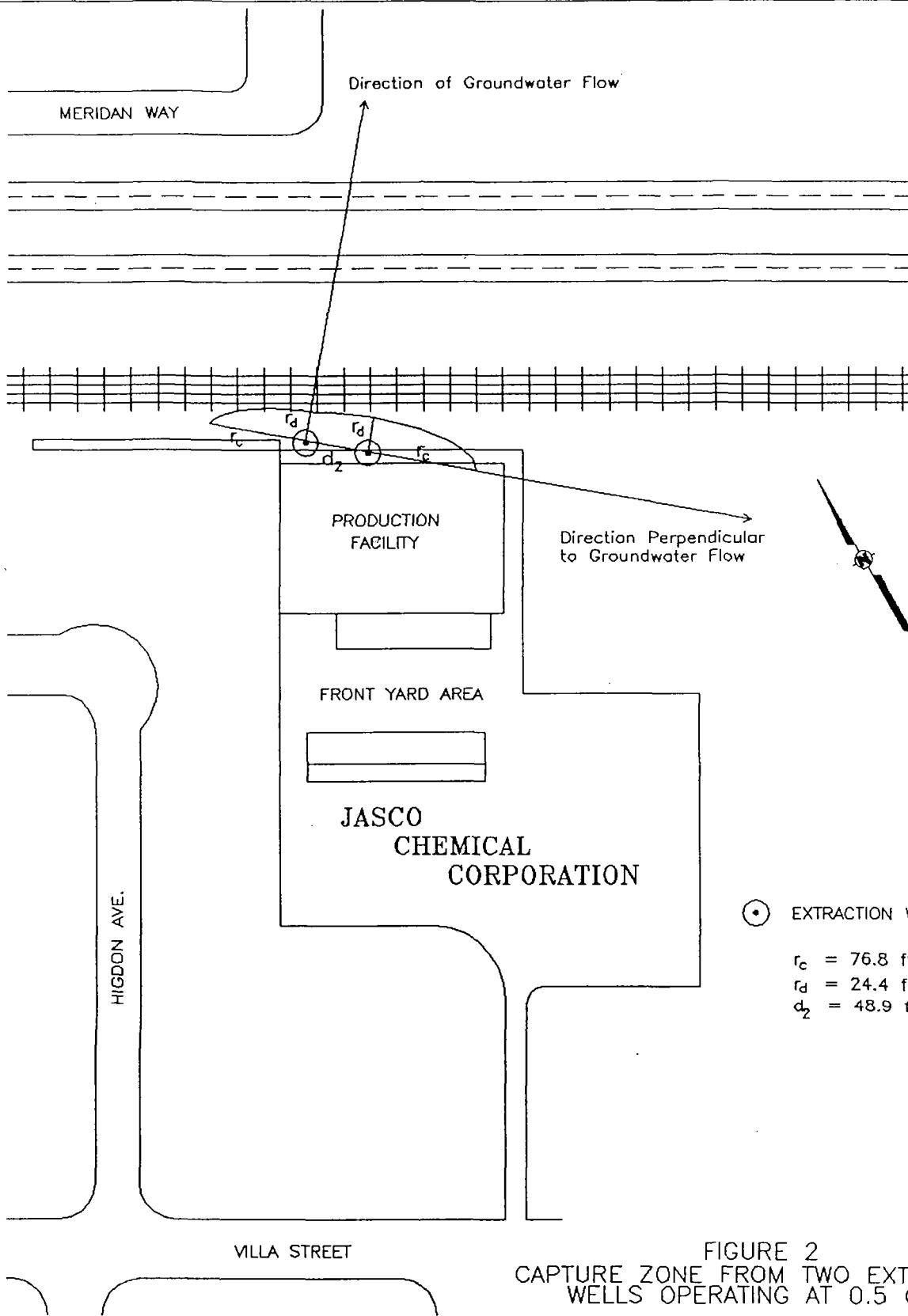
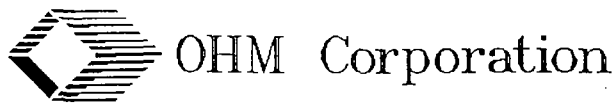


FIGURE 2
CAPTURE ZONE FROM TWO EXTRACTION
WELLS OPERATING AT 0.5 GPM

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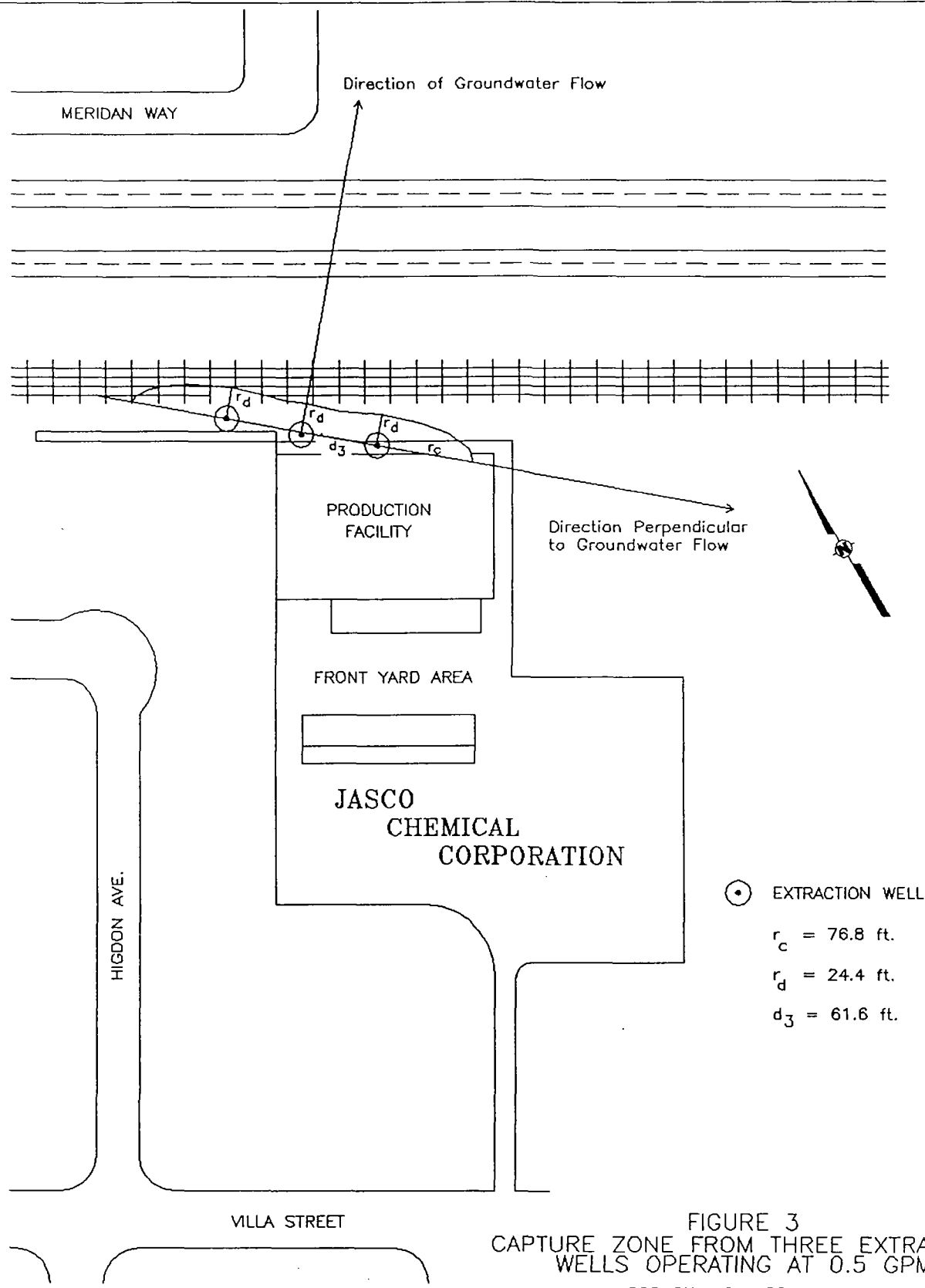


FIGURE 3
 CAPTURE ZONE FROM THREE EXTRACTION
 WELLS OPERATING AT 0.5 GPM

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